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PRESIDENT MESSAGE

The Pakistan Foundry Association (PFA) has been in existence since the year 2004 and focusing on training and educating our foundry Technical Personnel to manage and improve the efficiency of our foundry.

During the year, PFA organized training session for trainers for two days - on Nova Cast-Simulation Software, conducted by Mr. Pontus Anderson- Nova Cast Sweden, at UET Lahore. The trainers trained in this session will be the teachers for various foundry groups and participants. The batch of trainers were trained in Casting(Filling & Solidification modules). The participants were from Qadri Group, Infinity School of Engineering and selected students of metallurgy department of UET-Lahore. This is an important step towards our vision of training owners and technical staff of small and medium foundries in use of technology software and simulate their castings at UET - Foundry Service Center, where they will be given free access to the use of this software. PFA will organize a second session on "Stress Simulation" in September 2018.

Pakistan Foundry Association's 25 members delegation led by Mr. Asim Qadri, participated in METAL CHINA Expo 2018, this year, on May 16-19, 2018 in Beijing, China with a view to promote China/Pakistan Foundry association cooperation for up gradation in technology through mutual collaboration and joint ventures.

We are grateful to China Foundry Association for their warm welcome and hospitality.To reciprocate PFA has invited Leading Chinese enterprises to participate in International Foundry Congress & Exhibition (IFCE-2018), to be held on 14-15th November, 2018 at Pearl Continental Hotel, Lahore-Pakistan.

I am looking forward to a great learning and technology upgrading opportunity at IFCE foundry technology Workshops and Seminars during two days of exhibition for local foundries and participants from various industries, conducted by International foundry experts/ consultants.

I would like to invite all PFA members, international exhibitors, technical decision makers from local industry, machinery manufacturers, foundry material suppliers, service providers and investors to join us at IFCE-2018 to benefit from this mega opportunity and make it a success.

Sikandar Mustafa Khan
President - PFA

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Casting Impregnation: Modern Processes

Dr. Mark Cross,
Commercial Sales Director,
Ultraseal International,
Courtesy: Foundry Trade Journal

Vacuum impregnation is a reliable and permanent solution to the problem of porosity in casting. Undetected, porosity in any single cast part could compromise the performance of the component or system, leading to corrosion, pressure loss, fluid loss or even total failure

Many companies around the world that embrace sealant impregnation of die cast components as routine quality enhancement now favour modern methods of vacuum impregnation. These methods employ high quality sealants to maximise quality in low cost, fast cycle time, environmentally friendly processes, which dispense with the need (in the majority of instances) for added pressure, thus increasing efficiency with shorter cycle times.

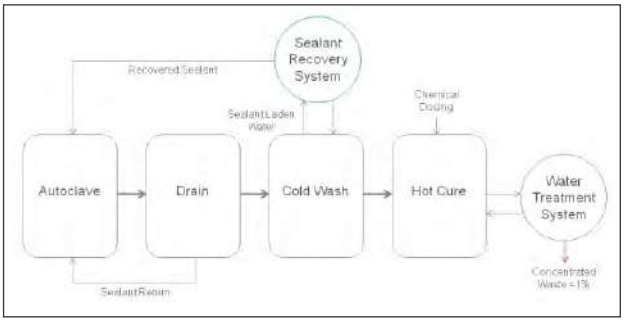

Fig1: Ultraseal Full Closed Loop Impregnation System

Cutting Edge Sealants

Two sealant technologies now dominate vacuum impregnation - anaerobic and thermocure. Both of these technologies use similar base chemicals, but with different curing systems; the performance and ease of use of each are significantly different:

Anaerobic

These sealants are formulated so that curing of the resin occurs at room temperature. As such curing times are typically very long, up to 24 hours, rendering the process unsuitable for modern JIT (Just In Time) production facilities, with pressure testing not possible until curing is complete.

Additionally, the sealants are unstable and require significant maintenance to ensure unwanted bulk polymerization in the autoclave does not occur (constant refrigeration, aeration and reactivity checks). Typically, this technology is limited to sections of North America and Mexico.

Thermocure

Thermocure sealants now dominate the global impregnation market. Introduced in the 1970s, they were rapidly adopted due to their fast curing times. These products are based on methacrylate monomers that cure in the presence of heat. Development of this technology since its introduction means this class of product can be subdivided into two groups:

- non recycling sealant
- recycling sealant

Non-recycling sealants were the first thermocure products to be introduced to the impregnation market. They are now a relatively old technology, having been used for the past 40 years. However, they still offer reasonable sealing performance, and are widely used in particular markets. Thermal resistance of these products tend to be limited and some formulations can also lack the correct adhesion and flexibility characteristics required to give optimum performance in the harsh environments that they operate in.

The Myth of Recoverable Sealants: A Crucial Distinction

Confusingly, some describe these thermocure non-recycling sealants as "recoverable sealants" - referring to the part of the process where some sealant can be "recovered" after the impregnation stage and before the washing stage (drain or centrifuge). However this is a false

distinction: all sealants can be (and are) recovered, via a drain or centrifuge, after impregnation and before the cold wash stage. The term "recoverable" is not a differentiator. There is no such term as a unique "recover- able sealant" category. Even anaerobic sealants can be (and are) recovered. The crucial distinction that exists in the thermocure sector is between recycling and non-recycling sealants.

With non-recycling sealants, resin removed from the surfaces of components during the wash stages of the impregnation cycle cannot be reclaimed. As a result, a very high volume of effluent is produced that is both difficult and expensive to treat. After a relatively small number of cycles the wash water must be replaced to prevent unwanted sealant contamination of components.

This leads to a very high effluent output and a wastefully high consumption of sealant. For example, a typical moderate user of non-recyclable sealant may consume 3,000 gallons of sealant a year, of which 2,900 gallons is simply washed away in the waste water.

Cutting Edge Modern Sealants are Recyclable

The cutting edge of sealant design is represented by recycling thermocure sealants. These give high sealing rates, last longer in service through increased thermal stability and reduce the costs and environmental impact of the impregnation process as far less effluent is produced when compared to non-recycling thermocure sealants.

Recycling sealants combine high performance with marked environmental benefits: the majority of the sealant which is removed from the surface of treated components in the cold wash stage is recovered and returned to the autoclave for immediate re-use in the first stage of the impregnation process. This drastically reduces the consumption of sealant - by up to 95% - and eliminates up to 95% of the effluent stream.

There need be no compromise in performance with recycling sealants - indeed some, such as Rexeal 100TM, offer exceptional efficiency, being effective at temperatures of up to 220°C (428°F) and being independently verified as achieving US military specification MIL-I-17563C (Class 1 and 3), an internationally recognised quality standard.

Figure 2 shows the Ultraseal's Sealant Recovery System (SRS) where the sealant which has been collected from the wash tank is passed through the system for retrieval and reuse. Contrary to some perceptions, recycling sealants have an unlimited pot life as with non-recycling sealants. The process control requirements of these products are also no different to conventional non-recycling sealants.

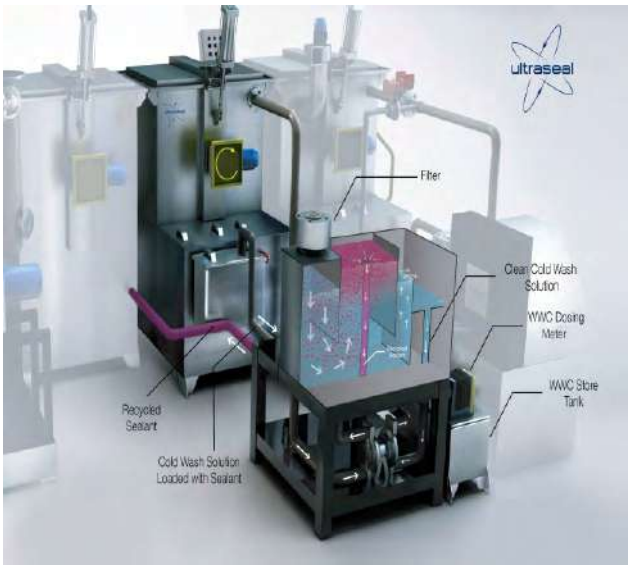

Fig 2: SRS diagram

Another misconception is that additional refrigeration is required, when in fact the only cooling required is to keep the impregnation vessel at a sensible ambient temperature of below 25°C (77 °F) - the same requirement exists for all thermocure sealants. Nor do recycling sealants incur higher operating costs: in fact the opposite is true, recycling sealants are designed to have lower operating costs than non-recycling sealants through reduced chemical consumption and effluent; reduced handling and greater machine up-time.

Pressure vs. Non-pressure

The process used to apply the sealant is also important. Today modern impregnation methods

are achieving excellent results without recourse to applying pressure after the initial application of sealant.

In the first stage of impregnation, the parts are loaded into an autoclave and a vacuum applied to draw air out of any porosity before the sealant is applied. The practice of applying pressures of up to 6 Bar after initial application of sealant is known as Dry Vacuum and Pressure Impregnation and dates back decades to the 1960s before modern impregnation sealants, which are less viscous than previous sealants, were invented.

Still used in some countries and in a few specific applications, adding pressure to the impregnation process is believed to drive sealant more effectively into any porosity. However research carried out by the University of Plymouth showed that this effect was minimal at the lower viscosities which modern recyclable sealants have.

The university developed a software mathematical model which allowed researchers to investigate the outcomes for varying pore size, specific gravity, viscosity, initial vacuum and the application of extra pressure.

As shown in Figure 3, the model demonstrates that, for porosities of 5mm length, of varying diameters between 250 microns to a few nanometres, the pore would fill very quickly at ambient pressure, in less than one second, for liquids with the low viscosity of modern recycling sealants (typically 6, 7 or 8 centipoises).

While adding additional pressure of 5 Bar would speed this up further, it was unnecessary as the time for impregnation was already so fast.

While modern recyclable sealants can fill porosity in less than one second, the results were different for more viscous liquids such as the older-fashioned sealants. The model showed these took a significantly longer time to impregnate completely.

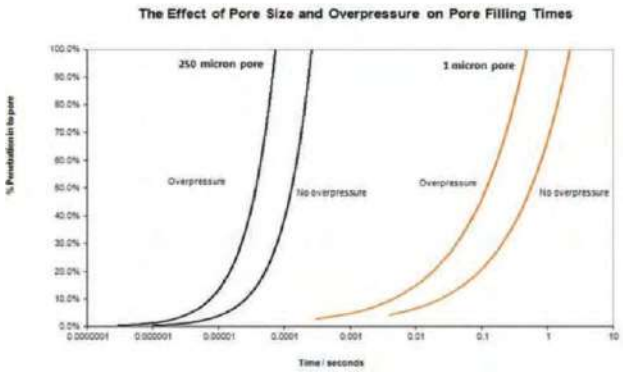

Fig 3: Effect of pore size and overpressure:

Simple table top tests2 on both aluminium and iron test rings have borne out these predictions. Test rings with 20% porosity were effectively 100% impregnated with a simple vacuum impregnation without the application of any additional pressure.

Globally, dry vacuum impregnation is the most widely accepted form of impregnation especially for gearboxes and engine blocks. Pressure impregnation originated from a time when it was a necessary step to compensate for the weaker characteristics of an older sealant technology; new sealant technology has replaced the need for additional pressure in many areas of the World. However, some special applications may still require the extra step.

Overall, to increase the efficiency of the impregnation process and realise the benefits of shorter process times, without any impact on the process effectiveness, additional pressure generally need not be applied.

For more information on which impregnation option is right for your die-casting facility, visit: https://www.ultraseal-impregnation.com/gb/dedicatedlandingpage

References

1. Modeling of casting impregnation using a single open pore model "; Dr G. Peter Matthews, 2003
2. Tests carried out at Ultraseal International www.ultraseal-impregnation.com

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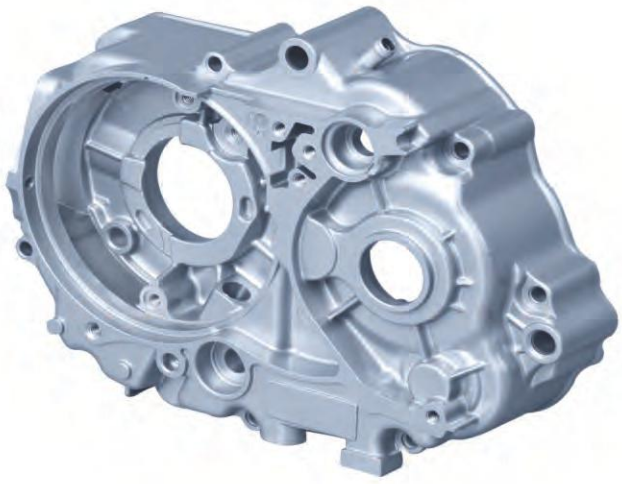

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Company Profile

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Qadir Engineering is famous for high pressure aluminium die-casting. Qadir Engineering specializes in the manufacturing of motor-cycle auto parts like clutch cover, crank cases, front and rare wheel hub, front and rare brake panel plate, brake shoe and different kind of service line material for Sui Northern Gas Pipelines Limited Lahore and Sui Southern Gas Company Limited Karachi.

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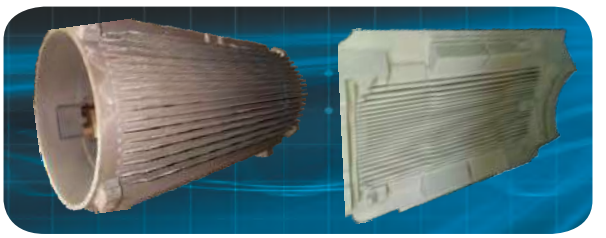

Providing Customized Solutions

Forace Group is a name synonymous with reliability. As the largest producer of Foundry Consumables in India, we offer a wide range of solutions to our ever increasing clients across the globe. Backed by robust infrastructure, a state-of-the-art fully automated manufacturing unit, R & D and Quality control centres, Forace Polymers delivers customized solutions for Binders, Coatings, Foundry Consumables, Phenolic-Liquid and Powder Resins.

Binders

Shell resin system (solid / liquid / regular / NF)
Two part no bake acid cured system
Two part no bake ester set system (steel, SG, NF)
Three part no bake alkyd
Phenolic urethane self setting system (steel, Iron, NF)
Phenolic urethane gassing cold box
Hot box system for ferrous & non ferrous
Furan no bake (steel, SG, CI, NF)
CO_2 cured phenolic
Inorganic no bake system

Coatings

Zircon spirit/water based
Graphite spirit/water based
Alumino-silicate mix refractory spirit/water based
Magnesite spirit based
Graphite water base for metallic trough
Bismuth base coating
Coating for lost foam process
Tellurium base coating
Sulphur blocking coating

Other Foundry Consumables

Thinners
Pattern cleaning agents
Release agents
- Release agent for green sand mould
- Release agent for alkaline phenolic no bake system
- Release agent for cold box
- Parting agent for shell (water / solvent based)
- Aluminium based release for no bake system

Core joining paste
- Hot to hot
- Cold to cold
- Cold to cold (ultra fast)

Collapsible agent for silicate
Mould sealing rope
Surface hardner for green sand mould
Sealing compound for mould and core
Silicon carbide, zirconia foam filters
Ceramic sand
Chromite sand
Slag coagulant (perlite ore)
Sand Additives (Sphereox) of Chesapeake Specialty Products, USA
Furnace & refractory cleansing fluxes of ASI International, USA
- Redux EF40L briquettes
- Redux EF40 bricks

Sphere-O-Dox G- high potency post-inoculant of ASI International, USA
Resulf-30-IE inoculant enhancer of ASI International, USA
Additive for thermal reclamation of alkalinephenolic no bake resin
Anti Veining solution from John Winter & Co., UK

Non Ferrous Foundry Consumables

Forace die coatings
- Graphite based die coatings
- Silicate based die coatings
- Aluminium based die coatings
- High pressure die coatings
- Zircon water base dressing
- Graphite based lubricant (plunger lubricant)

Forace degasser
- Forace degasser N2 (nitrogen based)
- Forace degasser CF (chlorine free)

Forace grain refiner (powder & tablet)
Forace cover fluxes
Forace modifier
Forace mastic
Forbral
Forbruss
Ceramic alumina foam filter
Master alloys
Others for refractory industry

Shell Resin Coated Sand

Forsand AC (for anti cracking grade)
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Instrumentation & Process Control for Energy Efficient Operations

Vishwas Kale
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Vijayesh Instruments Pvt Ltd, Pune
Courtesy: Indian Foundry Journal

Foundries urgently need to go green. There is ample scope of making foundry operations green. At present, clean technologies are available for manufacture of castings. Use of eco-friendly input items is also a green practice.

Green instrumentation can also abate pollution remarkably. In fact, energy savings is part of green initiatives in a foundry ensuring lesser emission and reduced hazards. Through energy saving measures foundries could ensure not only clean environment but also energy conservation.

Introduction

Instrumentation is a vital source for energy conservation; its resourceful use is quite possible. Saving energy is important for environment as well as cost control. Resource means source or possibility of help. Resources are means of raising money, or means of support. Instrumentation has a great potential for help: in measurement, control and logging data.

Temperature

For any combustion control and monitoring, temperature measurement is very vital. However, this important aspect is surprisingly neglected even in quality conscious companies today. For process standardisation, accuracy and repeatability of measurement is essential.

Non-contact infrared instruments

Infrared instruments read temperature directly using a sensor to detect heat radiation. When a thermocouple is installed in a furnace, it really indicates the temperature at the tip of the thermocouple. It may not detect the changes in the speed of jobs (on a moving conveyor) or the amount of material (in the furnace).

Thermometers

An infrared thermometer will not indicate the environment however, will measure the real temperature of the product. As they do not touch the product, infrared thermometers are ideal for moving objects, because they do not interfere with the process. Selection of the correct instrument and its installation are very critical. The right instrument is the one which has the shortest wavelength. As one works with shorter wavelengths, the emissivity of metal is higher. Therefore, if shorter wavelength instruments are used, the lowest temperature that can be measured is limited. For example, a 1-micron instrument can measure lowest temperature of about 480 0C while a 1.6-micron instrument can measure about 260 0C.

Another advantage of using the shortest wavelength instrument is that a change in emissivity has least effect on measurement accuracy.

While measuring product temperature inside a furnace, the infrared thermometer may read energy from the product, as well as part of heater energy, reflected from the walls. This may make the instrument to read too high a temperature of the product. It is possible to correct this using the latest technology by measuring temperature of the furnace walls or heater, by using a thermocouple or another infrared thermometer. With software calculations, this reflected energy is subtracted from the primary instrument. Economic considerations generally make the choice of another thermocouple more useful.

The hottest part of the furnace is at the door, where the product leaves the furnace, as the surrounding area is with a much lesser temperature. The infrared thermometer reads only this hot part and it is the best and most accurate temperature measurement. The user will want to know this temperature.

Sometimes, users want to apply a two-colour instrument. This instrument does not need the pre-condition that the cone is filled entirely with hot product. As a result, it becomes easier to work with smaller products. But this instrument is not ideal if there are reflections of energy around. The reflections have a greater effect on two-colour instruments.

Keeping the instruments in a clean area, or cleaning the lens regularly, ensures that they perform for years, as they are quite robust.

Selection of thermocouples and compensating cables

A good sensor must have fast response, good accuracy and long life. A grounded thermocouple will give faster response. Any thermocouple or system which gives faster response, always saves cost of operations. The insulators used in the assembly of sensors should be of sillimanite or alumina material, so as to offer excellent resistance properties even at high temperatures. The thermocouple will also have longer life.

Selection of protection tubes and thermo wells depends on operating and maximum temperature, environment (corrosive, oxidising, reducing, neutral etc.), adequate response time, thermal and mechanical strength requirements, pressure and flow velocity of the measuring medium.

The compensating cables have characteristics similar to the thermocouple used, up to 100 0C. They have insulation greater than 5 Mega ohms at 500 VDC, and also shielding to eliminate electrical noise and other disturbances prevailing in the foundry. These are connected with correct polarity. Incorrect connection will result in appreciable error.

Sheath	Recommended Max. Temperature	Application
Ceramic High purity Alumina	1870^{0}C	Annealing
Ceramic Sillimanite	1500^{0}C	Annealing
Inconel 600	1150^{0}C	Annealing Carburising
SS 304 / SS 316	900^{0}C	{ Hardening
28% Chromium Iron	1000^0 C	{ Nitriding
Nickel	1000^{0}C	{ Salt bath (Cyanide)
28% Chromium Iron	1000^{0}C	Salt bath (Neutral)
Ceramic	1000^0 C	Salt bath (High Speed)

Thermocouple Types

International Symbol	Names of Materials	Useful Application Range
B	Platinum 30% Rhodium (+) Platinum 6% Rhodium (-)	1370 to1700 °C
E	Chromel (+) Constantan (-)	95 to 900 °C
J	Iron (+)Constantan (-)	95 to 760 oC
K	Chromel (+)Alumel (-)	95 to 1260 oC
R	Platinum 13% Rhodium (+) Platinum (-)	870 to 1450 oC
S	Platinum 10% Rhodium (+) Platinum (-)	980 to 1450 oC
T	Copper (+)Constantan (-)	-200 to 350 oC

New economic thermocouples

Now-a-days, commonly used thermocouples type K and type S or R are replaced by new thermocouples type Ni-0.8Co/Ni-18Mo (range -200 0C to 1300 0C) and type C W-5Re/W-26Re (range 0 to 2315 0C).

Surface temperature of furnace wall

The metal furnace walls get heated and are also a source of heat loss. A leaf type thermocouple mounted on a small handle and a portable temperature indicator is used to measure surface temperature. A small indicator with magnets at its back is also available. It may be "stuck" to the metal surface and the sensor measures the surface temperature.

Heat treatment furnaces

Most of the times, the actual temperature and the measured and controlled temperatures are different. This happens because of the location of the thermocouples and furnace. The furnace design also plays a very crucial role in this regard. Incorrect calibration of thermocouples and controllers is another reason for this variation. For process standardisation, accuracy and repeatability of measurement are required. These depend on thermocouple characteristics, compensating cables, measuring instrument and its calibration, and finally, the actual method of measurement.

Heat treatment furnace

Temperature - uniformity and better control

- Always load the furnace to the full. Heat capacity of the load plays an important role in maintaining temperature inside the furnace.
- A circulating fan, suitable for hot atmosphere, could be used by mounting the same on the top. Alternatively, an appropriate blower may be used. This will keep the temperature inside the furnace at a uniform level.
- How does one know the actual temperature? By measuring the temperature of the job or the atmosphere in the furnace. It is to be made sure that the burner flame or the electrical heaters do not heat the thermocouple directly. The thermocouples have to be mounted accordingly. The thermocouple will measure the temperature at the tip or at the hot end.
- The thermocouples which should be correctly checked for their individual calibration get "aged" with use and start showing less temperature.
- The compensating cables may not be of correct characteristics matching the thermocouples in use. For K type, for example, red coloured correct cable must be used and must be checked whether they are connected correctly, i.e. positive and negative ends matching correct colour code.
- Temperature-measuring instrument should be checked for its calibration. If a temperature controller is used, the ON/OFF controller will give some deviation from set point and a PID controller will give very tight control. The accuracy of all instruments must be at least 0.25% FS.
- Are the burners self-proportioning type? They control air-to-fuel ratio correctly.
- If the oil used for burners is to be pre-heated, make sure it is heated to the specified temperature by actually measuring it. Only then the correct viscosity is obtained.

Furnace Temperature Mapping

Furnace temperature mapping is very essential for correct energy utilisation in any heat treatment. A good mapping report means that the furnace is used correctly with the best possible energy use and good product output.

Uniformity of temperature can be checked by furnace mapping. This is done by inserting many thermocouples inside the furnace and collecting data. The mapping is achieved by flexible bare or mineral insulated (MI) thermocouples placed inside the furnace. Use of MI thermocouple is suggested because bare thermocouple gets heated by the heat inside the furnace and gives inaccurate readings. The data is logged over a period of time and at different temperatures. There are procedures complying with standards. The thermocouples and instruments are used only after confirming their calibration. For specific furnaces, more solutions are possible. For example, a travelling thermocouple may be used. It will monitor temperature in different zones.

Procedure 1

Flexible thermocouples are inserted in the furnace and their sensing tips are located at the jobs where temperature is to be measured. The number of thermocouples depends on the points to be checked. They are connected to a datalogger/scanner. At predetermined temperatures and regular intervals, the readings are recorded.

The thermocouples, dataloggers/scanners have to have valid calibration certificates with NABL accreditation. The data is compared with the actual readings obtained from the thermocouples and instruments used. The API standard 6A specifies the requirements of thermocouples, instruments etc.

Procedure 2

System Accuracy Test (SAT) and Temperature Uniformity Survey (TUS) are carried out as per CQI version 3 and AMS 2750 E. The procedure is based on the furnace dimensions, working temperature, application of furnace, furnace class, instrumentation class, number of sensors to be used etc.

The SAT helps to understand the existing system of temperature measurement and control. The existing system is compared at working temperature with another thermocouple (master) inserted inside the furnace at the same location of the existing one and the other instrument (master). The SAT is done under actual working conditions.

The TUS is performed to find the temperature pattern at the working temperature inside the furnace with master thermocouples connected to a master instrument for data logging. It is done at the actual process conditions.

The certification involves many points, such as number of thermocouples, type of thermocouples, their locations, number of readings, interval of readings, readings before and after stabilisation, necessary accuracy of thermocouples used as master, valid certificates of thermocouples and data

logger used as master as well as that of instruments and thermocouples in use at the furnace, process of heat treatment (e.g. hardening, tempering etc) and test trials at different speeds. The SAT and TUS results indicate tolerance satisfaction. These may depend on the above-mentioned points. The list is quite long, but once understood, very easy to follow.

Mapping test is a very factual report of furnace behaviour. Claims of the furnace manufacturer are put to test. Though sometimes shocking, it helps to take corrective action.

Flame Detectors

These are essential features of any burner-using furnace for best utilisation of fuel, and for avoiding erratic operations (such as fuel being pumped without the flame etc).

Most flame detectors identify flames by so-called optical methods like ultraviolet (UV) and infrared (IR) spectroscopy and visual flame imaging. Flame detectors detect the absorption of light at specific wavelengths, and discriminate between flames and false alarm sources.

There are four primary optical flame-sensing technologies: ultraviolet (UV), ultraviolet/infrared (UV/IR), multi-spectrum infrared (MSIR), and visual flame imaging. They all use line-of-sight detection of radiation emitted in the UV and IR spectral bands by flames. Technologies may be selected to suit the requirements of flame monitoring.

UV flame detectors

UV detectors respond to radiation in the spectral range of approximately 180-260 nanometers. They offer quick response and good sensitivity at comparatively short ranges (0-5 mtrs).

UV flame detector

UV/IR flame detectors

If a UV optical sensor, coupled with an IR sensor, a dual band detector is created which is sensitive to the UV and IR radiation emitted by the flame. The combined detector offers increased immunity over the UV detector and has moderate speeds of response.

UV/IR flame detector

Multi-spectrum infrared flame detectors

Multi-spectrum IR flame detectors use multiple infrared spectral regions to further improve differentiation of flame sources from non-flame background radiation. These flame detectors are well-suited to locations where combustion sources produce smoky fires.

Visual flame imaging flame detectors

Visual flame detectors employ standard charged couple device (CCD) image sensors (commonly used in closed circuit television cameras) and flame detection algorithms to establish the presence of fires.

Industrial process flame detection requirements

It is necessary to consider the following points: False alarm immunity, Field of view, Detection range, Self diagnostics and Response time.

Gas combustion systems - sensors and optimisation

The objective of any combustion control system is to maximise the efficiency at the simultaneous minimisation of pollutants. Excess air means exhaust gas heat loss and lack of air means inefficiency losses due to incomplete combustion. For monitoring, the dynamic combustion process,

as well as for compensation of disturbances, fast response sensors are needed. They are placed into the exhaust duct. These sensors are exposed to temperature, humidity, pressure, water stream, HF, SO2, SO3, H2SO, ash, dust, vibrations etc. Therefore, sensors based on solid electrolyte ceramics are used.

A typical combined sensor for O2 and COe will have the following measurement range: for O2 : 0-21 vol % and for COe : 0-1,000 ppm. The response time is less than 10 seconds. A typical COe curve when slowly reducing O2, heading towards incomplete or bad combustion, shows increase of combustibles Coe at the emission edge due to lack of combustion air.

COe/O2 optimisation (emission edge strategy) means adjusting air-to-fuel ratio dynamically towards a smaller air value without influencing the burner firing rate until COe sensor signal spreads from the O2 sensor at the emission edge.

The CO_e/O_2 optimisation have the following advantages over O2 control:

- Higher energy savings through continuous self-optimisation at every load point
- Better control performance through shorter setting times
- Independent of false air
- Failsafe
- Robust
- Maintenance free

Programmable Logic Controllers (PLC) and Automated Heat Treatment Systems

For energy conservation, this offers tremendous potentiality. The PLC will have 92 mm width and 250 mm depth. All electronically printed circuitry will be masked to protect it from shop-floor moisture, conducting dust etc and to make it trouble-free from vibrations etc. This small gadget will include features which may otherwise require several individual units to achieve. This will mean lower installation wiring and commissioning costs as well as simpler operator interface.

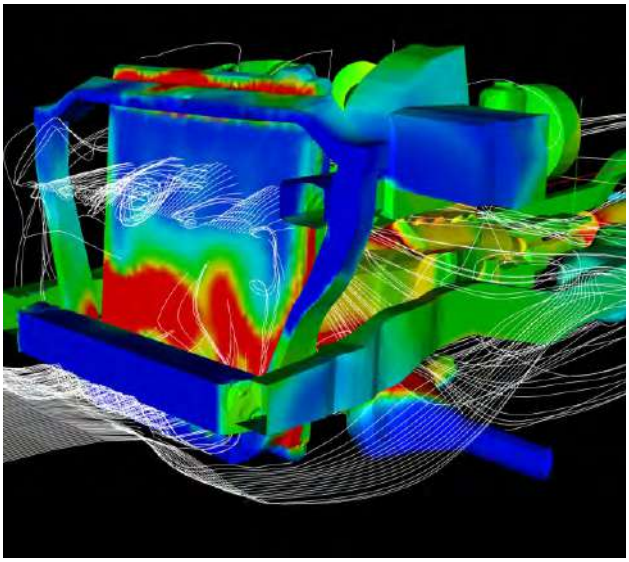
Features include: Any calibration is possible on shop-floor (e.g. temperature, pressure, flue gas etc), accurate programmer control, advanced self-tuning strategies, real time clock, timer, totalisers, programmable logic, mathematics functions and flexible integration. Thus, a PLC may be used at any place in the plant by just readjusting its user-friendly features.

Many typical and proven applications are:

- Furnace, atmosphere, oxygen and carbon potential control for carbonising atmospheres.
- Cascade control to improve furnace stability and accuracy of actual load temperature.
- Programmed logic temperature ramps and dwells for single and multi-zone applications.
- Control of fuel-to-air ratios, thus providing precise adjustments for optimum firing conditions.
- Pulsed burner control to save fuel.
- Vacuum furnace applications, where sequencing of events and interfacing with other equipment is an integral part of the process.
- Logging and recording of product batches, analysis of furnace performance, alarm and event analysis, storage of receipt thus providing repeatability and reduced setup times, mimic display of process for ease of operator interface, charts and reports to accompany the product.
- For lower temperatures, say up to 1000 0C (which are achieved by electrical heaters or resistance elements), a thyristor-driven unit will pass necessary currents to control the temperature. For higher temperatures (for which tungsten or silicon carbide are used), the thyristor unit will automatically adjust itself to the changing characteristics of the heaters (such as aging which causes complications). This prolongs the life of these expensive elements and reduces running and maintenance cost.

Thermal analysis

Iron foundries use a measurement called carbon equivalent, expressed as CE = C + Si/4 + P/2. This is an excellent guide to mechanical properties such as tensile strength, hardness, machinability, graphite flake size etc. Foundry's problem of determining both carbon and carbon equivalent features quickly on the shop-floor for making corrections to the molten iron is solved by this thermal analysis method. The measurements are fairly accurate e.g. within 0.05% carbon. The only care an operator has to take is correctly filling the resin sand cup without interrupting and with the necessary superheat. There is less chance of an incorrect reading in this method, because if there is any fault in the system then the readings fall well outside the expected range.



Thermal analysis

To achieve such thermal analysis with no rejection of samples, requirements to be followed are:

- Sample should solidify white.
- Pouring of metal must be at a high enough temperature to obtain liquid arrest point.
- Iron must not be heavily nucleated by inoculation or by melting technique.
- Metal must not be treated with Magnesium or Cerium.
- Metal should not be heavily alloyed. This may affect the eutectic arrest points.
- Verify the calibration of instruments regularly.
- Connect holder and cable correctly.
- Check chemical analysis against this method periodically, to ensure that the results are not affected by any changes in alloying elements.
- Carbon readings by thermal analysis should generally lie within +/- 0.05 per cent of results obtained by analytical method, and silicon readings should generally lie within +/- 0.15 per cent
- The cups must be free from moisture (warm them before use by keeping near the furnace). They should be always kept upside-down so that foundry dust does not fall in and spoil readings.

For determination of degree of nodularity of S.G. Iron, a special cup is used. The difference in thermal conductivity between flake graphite and nodular graphite is measured by a specially located thermocouple in a cup of specific dimensions. Thus, the solidification in one part cannot start unless it is completed in the other part. The cooling rate thus determines the conductivity.

Some typical values are given below:

Type	Thermal Conductivity Watt / M Deg C Medium Light Section	Heavy Section
ASTM A 48-74 class 25	50	48 – 54
Compacted graphite	47	42 – 48
S G Iron	32	36

In practice, the time (T 100) needed to cool from 1160 to 1060 0C is measured. A clear relationship exists between T 100 and the final solids temperature or T3 (taken 3 minutes after starting the pouring). If the cooling curve of an unknown type of iron is recorded, these parameters explain the actual point expected.

Calibration

Anything that affects a process must be checked for calibration. All sensors, instruments etc. can be checked either at the side or in a laboratory against standard equipments. The tolerances are to be decided on the basis of the process specifications by the process control manager. A calibration report is nothing but a fact-finding data, which will assist the user to improve the capabilities for better process control to get a quality product.

All those who are involved in the process must maintain the quality. Everyone contributes some view making the process best for achieving it. But it must be remembered that such points are not necessarily the ideal requirement. For example, the shop-floor engineer may demand a tolerance of + / - 5 0C temperature while tapping the furnace and the R&D engineer may demand a temperature with lesser tolerance. Someone has to decide the actual need, because it is going to affect the process. If a consensus is not reached then, unnecessarily expensive equipment and methods are used. It is worth noting that the user decides the process, tolerances etc, and this has nothing to do, in some cases, with the internationally accepted norms. Whatever affects the process must be standardised and checked.

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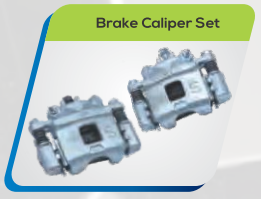

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Iron Foundry Banks On Thin-wall Casting With Eco Casting Process

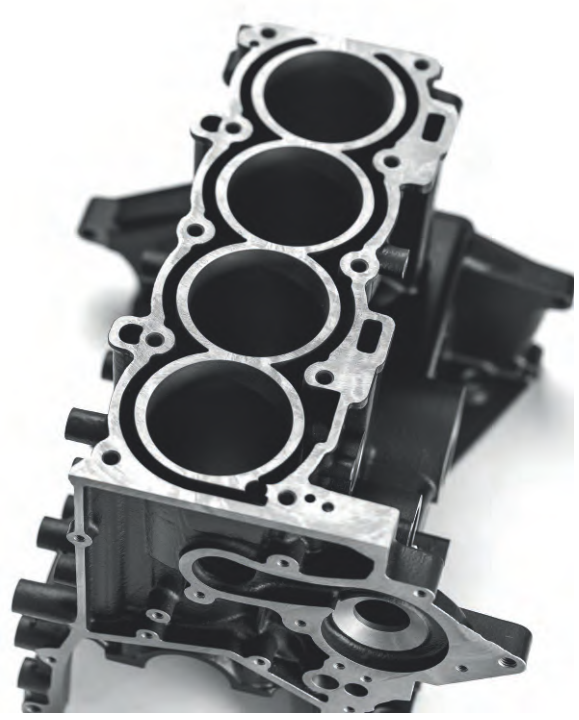
EDGAR LANGE,DÜSSELDORF
Courtesy: Casting Plant and Technology, International

Reducing the weight of engine components is a future-oriented strategy to save fuel and cut CO2 emissions.To this end, the German iron foundry Fritz Winter Eisengießerei, based in Stadtallendorf, uses a thin-wall casting process and the recycling material grey cast iron to make components such as engine blocks, the biggest and heaviest of all combustion engine components. The thus produced castings are extremely low in weight. With this innovative process, branded EcoCasting, the foundry is making itself fit for the future of automotive light-weight design.

Founded in 1951 as a family-owned company, Fritz Winter iron foundry today is the biggest independent jobbing foundry in Europe. It employs 3,700 people and serves approx. 400 customers.The foundry, based in the German town of Stadtallendorf, cast its first engine blocks as early as in 1959.Against the backdrop of the need to minimize CO2 and other hazardous emissions, competing drive concepts for vehicles were a much discussed topic at the 29th International Conference "Engine & Environment", held in Graz, Austria, at the end of May 2017. The conference was organized by the Austrian company AVL.AVL is the world's biggest independent company specialized in the development of drive systems based on combustion technology."Electric motor versus combustion engine" was a key topic on the conference agenda. According to Helmut List, CEO of AVL, the combustion engine is far from being thrown on the scrap heap:"The development of advanced combustion engine concepts has already led to a constant reduction in hazardous emissions and we can expect more technological advances to come," emphasizes List.

Grey cast iron versus aluminium

People attending the conference in Graz showed great interest in the new environment-friendly EcoCasting process presented by iron foundry Fritz Winter Eisengießerei GmbH & Co. KG, Europe's largest independent jobbing foundry and supplier and partner to international passenger car and utility vehicle makers as well as the hydraulics industry.The foundry is atypical tier 1 supplier to the big players of the automotive industry - from A as in Audi to Z as in ZF-Friedrichshafen. You are likely to come across an iron casting made by Fritz Winter in everything that moves. EcoCasting is Fritz Winter's new weight-saving brand, which is to trigger a rethinking in engine construction. The innovative iron casting process behind this brand makes it possible, for example, to cast light-weight crankcases for passenger cars as a competitive alternative to crankcases made of aluminium.



Revolution in iron casting

"We love to make heavy things light" is the iron foundry's mission.Cast iron and light-weight construction - two things that do not seem to go together well. How is that going to work?What

makes the thin-wall cast four-cylinder crankcases so special versus conventional iron castings is the fact that the new process developed by Fritz Winter is sandless.This providesexciting results:extremely thin walls of only 2.5 mm can be achieved at tolerances as low as 0.5 mm.What is more, making a motor block from cast iron involves 28% less costs than producing analuminium motor block by high-pressure die casting.Relative to aluminium gravity die casting the cost benefit is even greater.These comparisons are based on a 1.6 liter four-cylinder Otto engine as benchmark.

To achieve this, the Fritz Winter engineers have come up with a number of smart ideas:a highly compact engine design, an overallshorter engine length as a result of smaller distances between the cylinders, an optimized crankshaft main bearing and, above all, the unique casting technique which Fritz Winter for the first time in the world uses to make cast iron crankcases for passenger cars."When we pour the molten iron, it is as fluid as water, allowing it to fill the smallest cavities,unlike aluminium, which behaves similar to a semi-fluid," explains Richard Pausch, Director Sales of the Fritz Winter foundry. This is one reason why the new motor block has such a filigree design.Another positive effect is the high dimensional accuracy.The maximum weight deviation between the CAD model and the finished casting is below 100 grams.According to the foundry experts of Fritz Winter, it would be possible to cast wall thicknesses even smaller than 2 mm. However, this would get close to the feasibility limits as the casting still has to be suitable for fettling and shot-blasting.Even with the currently cast wall thickness, the difference in weight between a cast iron engine and an aluminium engine has shrunk to just 1.5%.

EcoCasting engine blocks are in great demand

Fritz Winter regards EcoCasting as a new branding within their light-weight product portfolio."Eco" stands for both "economic" and "ecological", hence sustainability.Already the production of light-weight EcoCast components requires significantly fewer resources than conventional ironcastings or comparable parts made of aluminium,especially because the raw material iron scrapis a genuine recycling product."Therefore we see ourselves as'true recyclers'," adds Pausch. He takes pride in the fact that the raw material of grey cast iron is 100 percent steel scrap.What becomes a motor block or a brake disc, may have been a railway track or a bicycle before.In contrast, primary aluminium, a ton of which currently costs about 1,900 US dollars, requires ten times more energy during production than cast iron."Therefore, we chose 'Aluminium was yesterday' as one of our slogans at this year's Vienna Engine Symposium, and actually caused some chuckling amongthe attending guests," recalls Sebastian Hahn, Director Marketing of the Fritz Winter iron foundry.

The light-weight components made by Fritz Winter are in great demand by its automotive customers. Already about 800,000 EcoCast crankcases have been shipped to customers so far.Fritz Winter is striving to offer the market a genuine alternative to aluminium and keep the foundry fit to respond to the future challenges of automotive light-weight engineering.According to Sales Director Pausch, iron castingswill remain unbeatable in terms of cost efficiency and have a great future potential.Richard Pausch is confident that iron is a material far from dying out.

Captions

An ecological and economic alternative to aluminium:thin-wall cast four-cylinder crankcase with wall thicknesses down to 2.5 mm at tolerances of only 0.5 mm.The concept of light-weight crankcases made of grey cast iron was a much discussed topic.Steel scrap, as used in this piece of art, is also the raw material of EcoCast products.

In great demand:"EcoCasting, the eco-friendliest casting process of all"

In an interview with CP+T, Richard Pausch, Director Sales of Fritz Winter iron foundry based in Stadtallendorf, Germany, talksabout the branding of the EcoCasting process, about iron as recycling material, the market for thin-walled iron castings and the prospects of EcoCasting products with respect to electro mobility.

You have developed the EcoCasting process and established it as a brand.What was the motivation behind this?

Our intention was to establish EcoCasting as a branding."Eco" encompasses both economy and ecology, forming a symbiosis of both.For a jobbing foundry as we are it is not easy to establish an own branding, because we do not offer standardized products on the marketplace - as,let's say, mobile phone manufacturers do.

What is your brand strategy?

One objective of our brand strategy is to replace the term grey cast iron, as the word "grey" does not prompt very positive feelings.We also plan to combine all our future light-weight activities under the EcoCasting label.

Which role does the recycling material iron play in this context?

A key element of our EcoCasting strategy is to highlight the fact that iron is an excellent recycling material. And that is what will be associated with this brand.

How has the market been accepting your innovative thin-walled castings?

There has been a lively demand for our products.The market currently demands small wall thicknesses, for example in crankcases, to be able to design components of lower weight.This is a fact no supplierof cast products wanting tosurvive in the market in the long run should deny.Our EcoCasting process is currently the eco-friendliest casting process of all.We are of course aware that no automotive customer will be willing to rely on a monopoly sourcing situation for thin-walled castings in the long run.Therefore it is essential for usnot to lie back but always stay at the leading edge of technology.With a competitive alternative to aluminium crankcases in the portfolio, Fritz Winter is heading towards becoming a global supplier.

How is Fritz Winter preparing for a future market characterized by a declining share of combustion engine-propelled vehicles and a growing number of electric vehicles on the roads?

Also in a world of growing electro mobility, we see market opportunities for Fritz Winter and much potential for new products based on thin-walled iron casting - for example, cases for batteries and electric motors and of course brake discs, which Fritz Winter has already been selling in great numbers, actually about 20 million a year.

Also here we strongly believe in a business success based on cost-efficiency and sustainability achieved through smart concepts of light-weight iron casting.As we have been convinced of the success of our new and highly innovative EcoCasting process from the beginning, we have invested more than 50 million euros in the implementation of a production line.Actually, the overall investment volume of a

thin-wall casting line is slightly smaller than in case of a conventional flask-based foundry, among others because no flasks and sand preparation facilities are needed.

Do you believe that the current discussion about weight-saving automotive engineering with a strong focus on aluminium is heading towards the right end?

Only ten percent of the global CO2 emissions is accounted for by automotive traffic.However, this fact is not always put in the right perspectivein the media and in political discussions.Also the fact that cars with aluminium crankcases would have to be operated much longer than their average lifetime in order to achieve the same CO2 balance as EcoCast crankcases is often disregarded.What has to be considered are the life cycle values. And here cast iron, with 1,783 kg of CO2 per ton of material produced clearly outperforms primary aluminium, which based on the world energy mix emits approx. 6,174 kg of CO2 per ton produced.Also political decision-makers should place greater emphasis on this aspect.

So, this means that you see good long-term prospects for your company in the field of innovative light-weight cast iron products such as the engine block?

Absolutely.What concerns me a bit is the risk that we may be loosing expert knowhow in this traditional field of technology.If in the years to come nobody was really interested in the further development of combustion engines any longer, we would be running short of qualified engineers in this field.This would be a great pity.

Captions

"Aluminium was yesterday" - Fritz Winter sees great future potential for grey cast iron.

These beverage cans caused some chuckling at the 29th International Conference "Engine & Environment" held in Graz, Austria.

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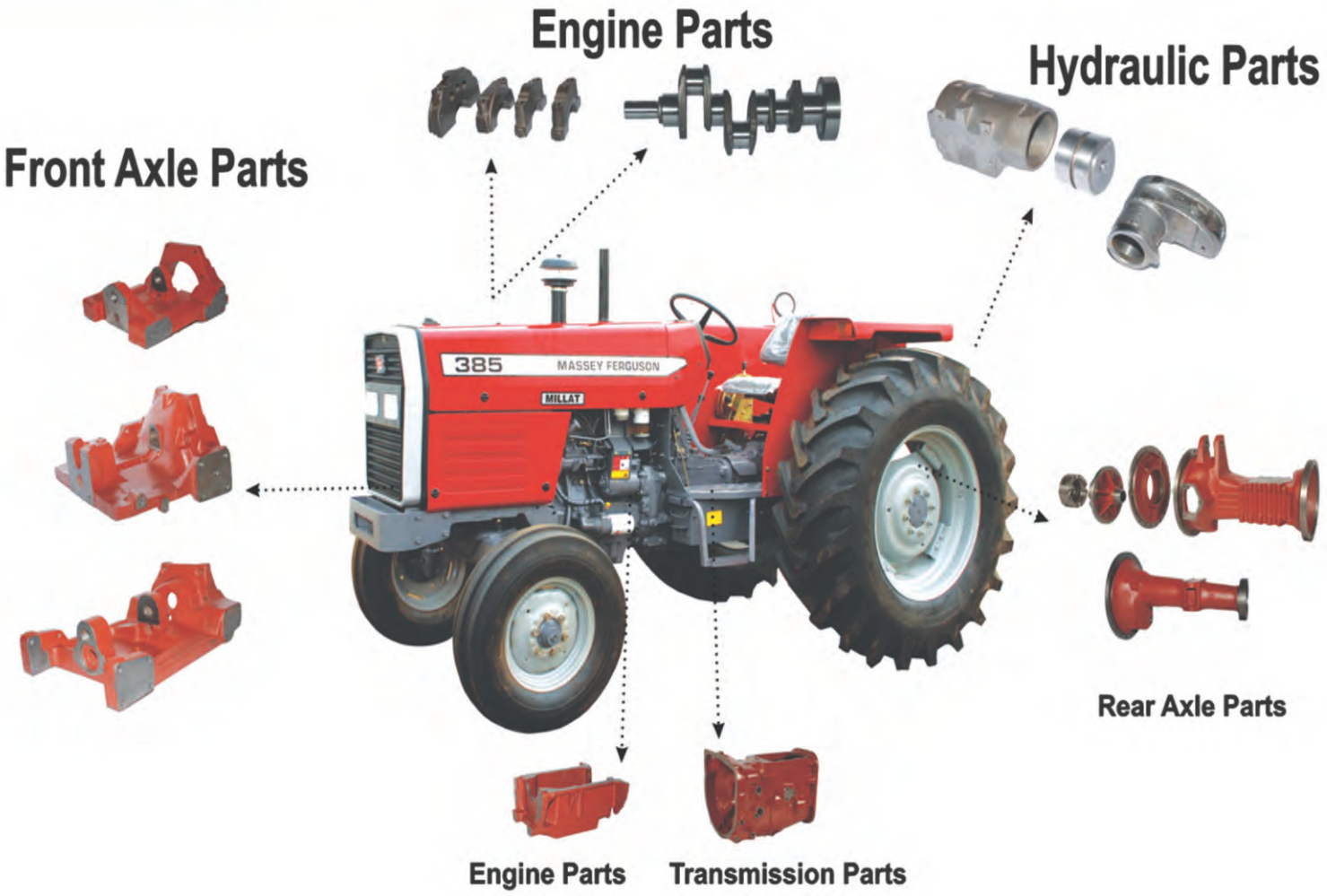

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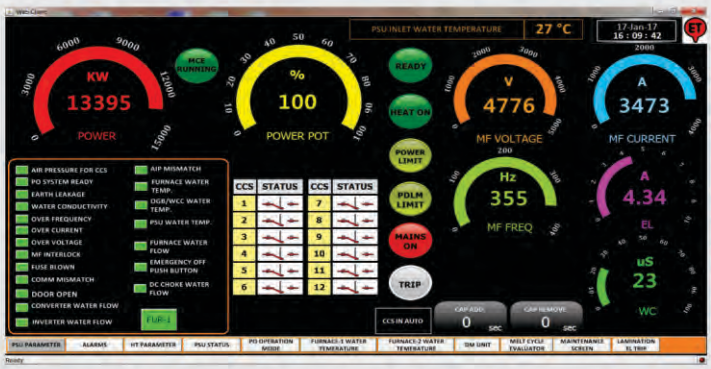

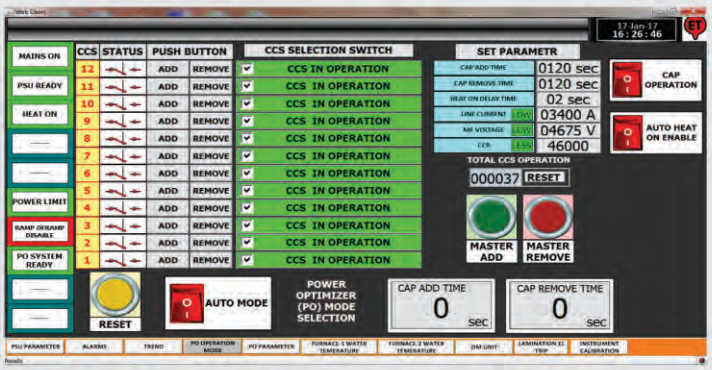

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Modified Silicate-Ester, a viable alternate for Organic self sets

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Abstract:
It is documented1that Sodium silicate CO2 process as Binder system for making moulds& cores in Foundries achieved acceptance in Europe in 1950i¦s i.e. before introduction of Organic Binders.Later on, liquid hardeners were introduced as curatives in between 1960 & 1970 for application of this system as Self set.
Inherent draw backs associated with CO2 cured Sodium silicate like poor handling strength, poor decoring, moisture absorption of moulds and cores on storage, poor reclamability of used sand and poor finish of castings requiring long rework time affecting productivity necessitated introduction of modern Organic self sets one after another from time to time starting from 1958.
At present, out of several Organic self sets, FNB (Furan) and APNB (Alkaline Phenolic no bake) are most popular in World as well as Indian Market.
However, all are not well with Organic Binders.Main concern associated with Organic Binders remain Environmental pollution associated with these systems at different stages like handling, mixing, pouring and finally soil pollution during disposal of waste sand.
Mechanical and thermal reclamation of used sand and recycling of same again and again has to a major extent taken care of minimization of excavation of new sand and disposal of used sand to protect Ecology & Environment ,but pollution of Environment by vapours of Organic liquids and gases due to cracking of Organic Binder systems remains a major concern.
Growing concern on Foundry Environment have compelled Binder manufacturers to think about re introduction of sodium silicate as Self set with modifications.
Work on this alternate Self set for last five years with modifications of the Binder to work at addition level as low as 2.25:10-15 with improved handling strength,adjustable BL and ST,improved collapsibility, better reclaimability of used sand and casting surface finish closer to that offered by FNB and APNB is being thought as possible alternate to both for many applications including flaskless moulds. Environmentally, this system is almost non-polluting when compared to FNB and APNB.

Introduction

Literature study2elaborate the use of this Self set in a paper published in 1982.
The system did not gain popularity immediately as Organic Self sets scored over the system in terms of collapsibility surface finish of castings and productivity.
With growing concern on environment and further improvements of the system over next three decades, same author published a paper3again in 2012 on the system with modification carried out in between.
Keeping in pace with development worldwide, Indian manufactures also have worked on the system and could formulate the system in line with expectations of Indian Foundries, matching varying demands of BL, ST, Strength properties and of course, casting finish and ease of knock out.

The system in brief:

This is a two part system comprising of a modified Sodium Silicate as Binder and series of Esters as Hardeners. Hardener compositions are adjusted to suit exact BL & ST requirements of individual Foundries.

TYPICAL PHYSICAL PROPERTIES

Binder: Modified Silicate

Appearance :	Viscous Liquid
Viscosity@30OC,cps(approx.) :	200-700
Specific Gravity@30OC :	1.51 - 1.54
NV (%) :	55-65

Liquid Hardener (s):

Appearance :	Water colored liquid
Viscosity :	Water Thin
Specific Gravity :	1.10 - 1.20

Addition Level:

It depends on quality of sand. In Indian sands, in

general, the system has been found to work with addition level in between 2.25- 3.5: 10-15.
In some sands from Southern part of the Country, it has been found to work with Binder addition of as low as 2.0% by Wt. of sand. Increase in Hardener addition above 15% does not have appreciable effect on BL, ST or Strength.

Mixers:

All types of mixers like batch,continuous and high speed bowl mixers are suitable for this process.

BL and ST:

BL of mixed sand can be as high 30 mts. at RT of 30oC and ST as low as 8 mts. ST to BL ratio for this system varies between 3- 4.

Hardeners:

Usually three grades are supplied according to BL and ST requirements. In Indian sands, BL and ST achieved with the grade at 30oC are as follows:

Hardener	Fast	Medium	Slow
BL (Mts. - Sec.)	2- 30	6- 30	25- 0
ST (Mts. - Sec.)	7- 30	20- 0	95- 0

Salient Features:

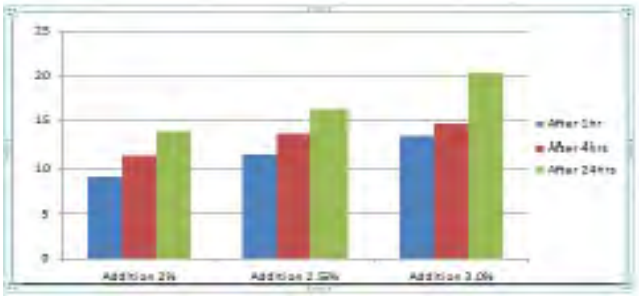
- Lower addition level than ordinary silicate
- Most environment friendly among all no bakes
- Free from N, S and P
- No obnoxious fume in mixing and pouring area
- Binder is water soluble
- Excellent hot strength
- Very low gas evolution
- Offers castings, free from usual defects
- Good Collapsibility
- Compatible with Silica, Olivine, Zircon and Chromite Sands
- Catalysts are nontoxic
- Flexibility of blending catalysts at all proportions
- Reclaim ability - fairly good
- Suitable for flask less moulds in FLL
- Reclaim-ability fairly good
- Compatible to water and thinner based coatings
- Viable economy

Regular Silicate:

Foundry grade Sodium Silicate when gassed in 12 cavity gang compression box with CO2 @ following Binder addition level in Jajjhar Sand has been found to provide hourly compression figure as tabulated below:

Addition (% by wt. of sand)	3.5	5.0
Immediate Compression (Kg/Cm2)	7.3, 8.0	10.6, 11.8
4 hrs	8.6, 7.5	11.9, 12.3
24 hrs	9.7, 9.8	12.3, 12.9

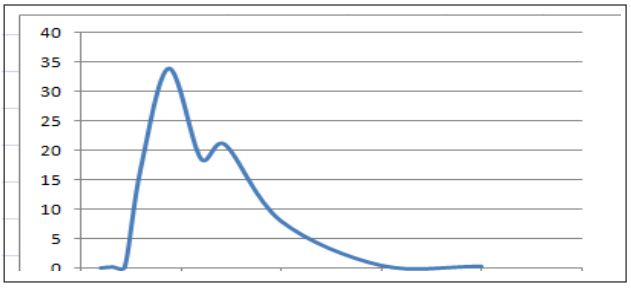
From above table, it can be concluded that10kg/cm2 compression is enough for handling boxed moulds and cores



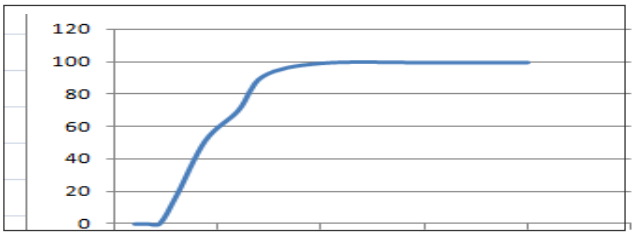
Bar Chart 1 (Jajjhar Sand)

Binder addition level vs Dry compression (Kg/cm2) for Self set silicate in Jajjhar sand with following distribution:

	Retention (%)	cumulative % retn
BSS No.		
16	0.016	0.016
22	0.198	0.214
30	0.175	0.389
44	16.987	17.376
60	33.908	51.284
72	18.566	69.85
100	20.968	90.818
150	7.967	98.785
200	0.437	99.222
-200+ Pan	0.293	99.515
	AFS=54.4	



BS Sieve No. vs % retn. (Not to scale)



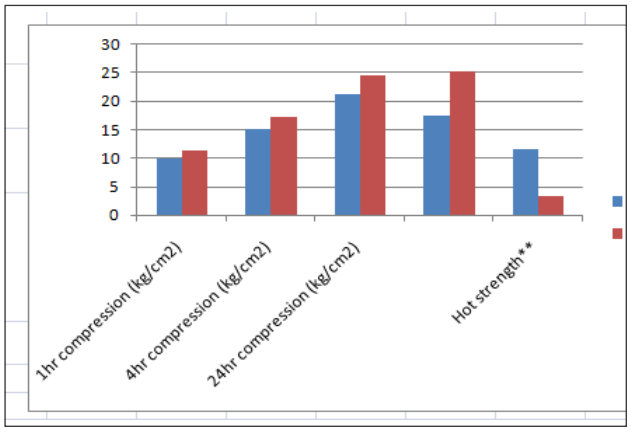
BS Sieve No. vs cumm. % retn. (Not to scale)

Silicate Self set

Regular Silicate V/s Modified Silicate

Sand : Guddur
Recipe : 2.5: 12.5
Hardener : Medium
RT : 31 iV 33oC

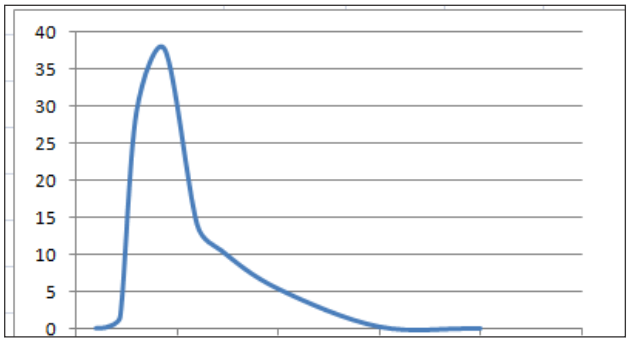
Bar Chart 2 (Gudur Sand)



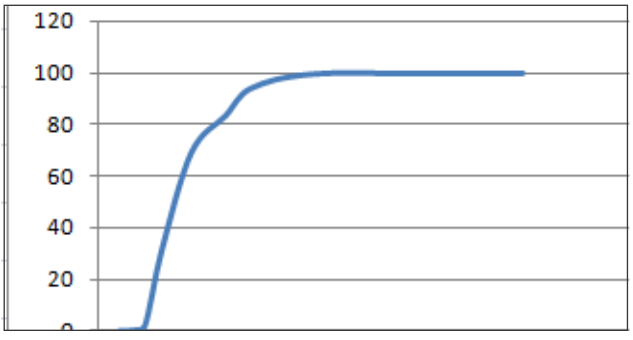
* 24hrs samples dipped in thinner based coating, ignited, allowed to cooled & tested for comp.
** Above coated cold samples kept in furnace @800OC for 1 hr,
furnace switched off, allowed to come to room temperature
and samples broken.

Gudur Sand

BSS No.	Retention (%)	Cumulative % retn
16	0.097	0.097
22	0.318	0.415
30	1.697	2.112
44	29.309	31.421
60	37.77	69.191
72	14.092	83.283
100	10.577	93.86
150	5.428	99.288
200	0.298	99.586
-200+ Pan	0.084	99.67
AFS No.	48.17	



BS Sieve No. vs % retn. (Not to scale)

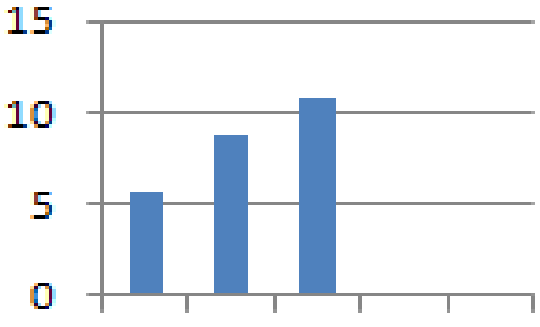


BS Sieve No vs cumml. % retn. (Not to scale)

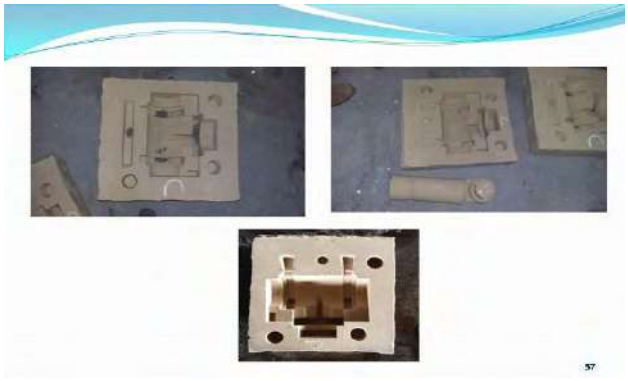
Modified silicate with olivine sand

Sand : Olivine
Recipe : 2:15
Hardener : Medium
RT : 31 iV 33oC

Bar Chart 3 (Olivine Sand)



- Hourly Comp. Strength (Kg/cm2)
- 2 hr samples heated in furnace at 650oC for 5 mts. tested hot for comp..
- 2 hr samples heated in furnace at 650oC for 5 mts. cooled to RT, tested for comp.



Moulds made with Self set Silicate in Thiruthuraipoondi Sand at 2.25:12.5

WCB grade casting in Self set Silicate @ 2.25:12.5 in:Thiruthuraipoondi Sand

Thiruthuraipoondi Sand										
BSS No.	-10+16	-16+22	-22+30	-30+44	-44+60	-60+72	-72+100	-100+150	-150+200	-200+ Pan
%Retention	0.34	3.63	1.65	11.72	22.44	23.1	22.32	12.68	1.49	0.47
AFS				60.25						

Reclamation of Self Set Silicate sand

Recycling of same sand again and again:

- Reduces BL of mixed sand
- Reduces refractoriness

Thermo mechanical process of reclamation5 has been found to be effective for this self set. Steps involved are:

- Heating of used sand in fluidized bed at 150 DC which removes moisture from silicate film on sand surface and increases brittleness
- Mechanical attrition removes silicate film from surface of sand
- Finally cooling, classification and de dusting is done in fluidized bed.

Conclusion

With increase in awareness about protection of Ecology and cleanliness of Environment in Foundries,it's time for Indian foundries to look beyond benefits offered by organic Binders over oldest inorganic Binders i.e. Sodium Silicate.

Undoubtedly, Sodium silicate scores over organic Binders in protection of Ecology &Environment friendliness, but deterrentfactors for its mass applications are poor dry strength, requirement for excess Binder addition, poor decoring characteristics, poor reclaim ability of used sand& so many.

Organic Binders were introduced in world market starting late 1950i¦s from time to time to overcome short coming of Silicate system. But their mass introductions in foundries are at the cost of pollution of Foundry Environment and disturbance in Ecology.

In the beginning of 2nd decade of 21st century, modified Silicate with liquid Hardener created attention as an alternate to Organic Self sets.

The modified version can be read as the optimized system balancing advantages offered by Organic Binders and cleanliness of inorganic Binder.

In all probability, Indian Foundries will adopt this Binder system for pouring all types of metals, ferrous and non-ferrous in boxed as well as flasked molds.

Over a period of time, reclaim-ability of the system will reach to the level offered by most of the Organic Binders.

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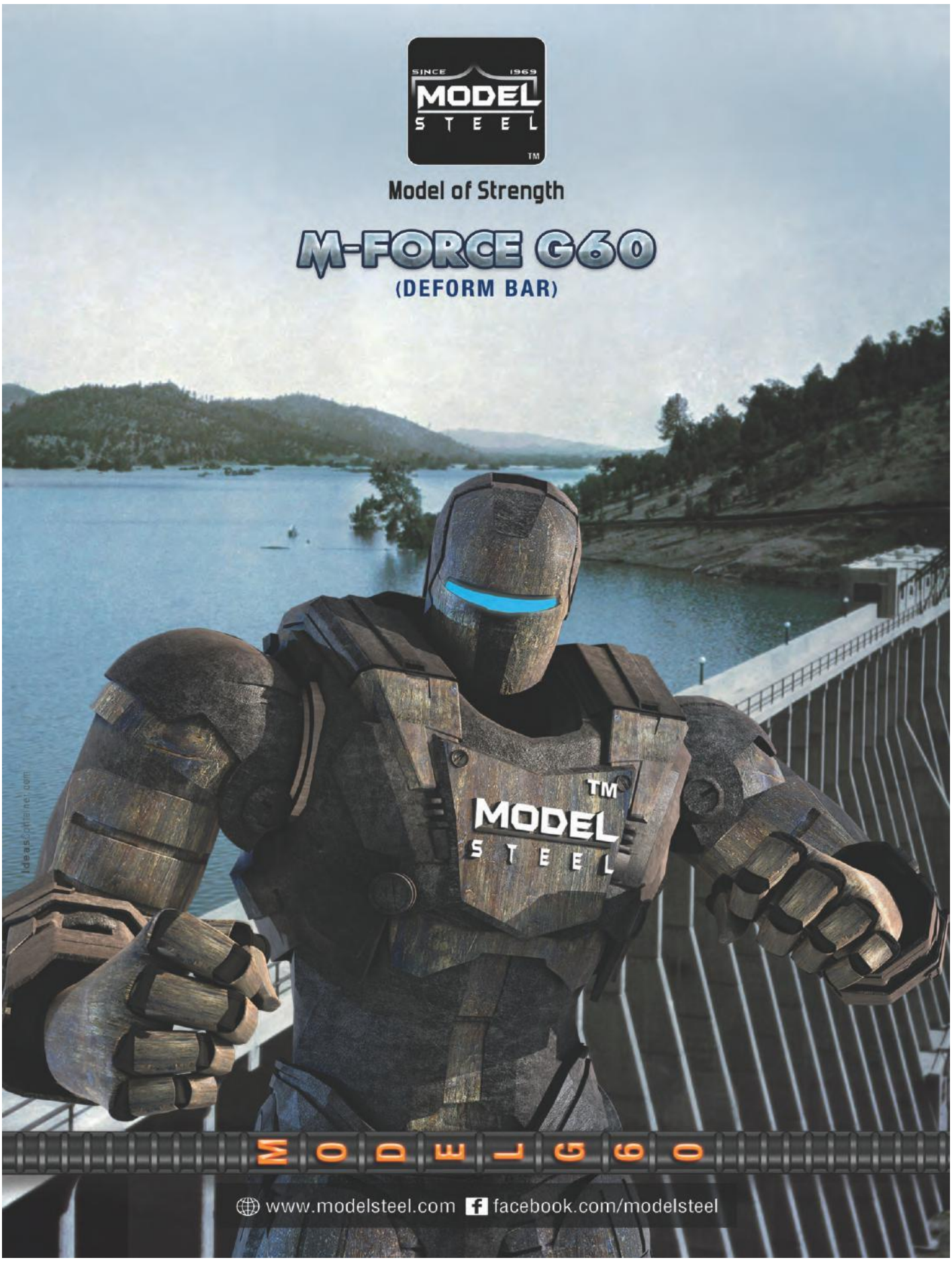
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Methods and Measures toReduce the Solder Defect of Die Casting Surface

Zhengyu Gao,
Quakerchem(China) Co. Ltd., Shanghai
Courtesy: Global Casting Magazine

Abstract:
The solder defect would affect the surface quality and strength of product, especially high seal requirement casting. The defect would lead leakage that more waste of cost. This passage analyze some cause of solder by four aspects such as chemical principle,mold structure, release agent and die casting process etc. and do some actions that reduce thereject ratio.

Keywords:
die casting;spaying;parameters;release agent;TGA More and more market competitions,

Fig. 1 Solder area of high

the customers give suppliers for higher requirement. It's difficult to meet customers' requirement whichstrength of casting passed only,and the surface quality is important too.It not only affects the casting surface quality, but also leads to some leakage defect. (fig1). Many suppliers can't deliver because of solder defectbut wasn't the best way to solve. Such as a JAC die casting company in Suzhou, China, which is a high quality of customer, that don't permit solder by naked eye.It makes the company pay more attention to solve this problem; A German company in Shandong, Chinawhich produce automobile parts. It's high quality requirement of solder, the defect area is no more than 20mm×20mm; a company which produce 3C market product, that thin wall and high temperature pouring, it's high risk to appear solder defect….

1. Solder defect reason

What factors cause the solder defect? What's the physical or chemical changing between the liquid aluminum and hot iron mold?The following instructions will find these results that from chemical principle, mold structure, release agent and die casting process.

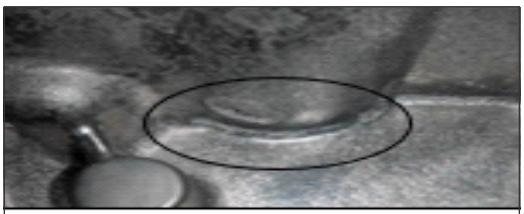
Interfacial reactionis a series of chemical interaction that occurs between the interface of two phases, according to chemical type, content, status and properties.

Solder defect is leaded by the chemical and physic reaction, due to the strong affinity in Fe-Al, it would born a new compound when the mold and liquid Al that connect closely,the higher temperature, themore intense of thermal vibration of atom, and the solder ratio would raise, the corrosion of mold would increase, finally, it will cause solder area, when be polished, the surface which contains a thin nitride layer will be destroyed, and cause worse cycle. Some data displayed that the affinity of Fe-Al will become serious when the Fe element decrease. It will bring more solder.

1.2 Mold design

1.2.1 The external source.

The solder defect was caused by unreasonable mold design and heat treatment. The purpose of nitriding that get high hardness and abrasion performance of moil surface. It will get 950~1200HV of surface hardness, and not decreased when the temperature raise 560~600℃ it will produce an oxidation film that has good property of resistant to corrosion,it will cause to rough surface if poor heat treatment that caused thin nitride layer; the small draft angle of mold or inverse draft with core or wall; the unreasonable gating system, which can lead to scour core and wall directly. Such as fig2.



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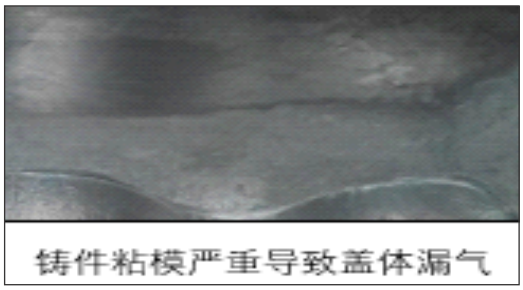

Fig.2 ： The solder defect of casting or mold

1.2.2 The internal source

Due to the dead zone of cool channel when design the mold, some wall was thick which lead to high temperature area, therefore it results in solder defect; the high temperature of ingate would be scour seriously.Suchas fig. 3.

F ig3 ： Solder area of ingate

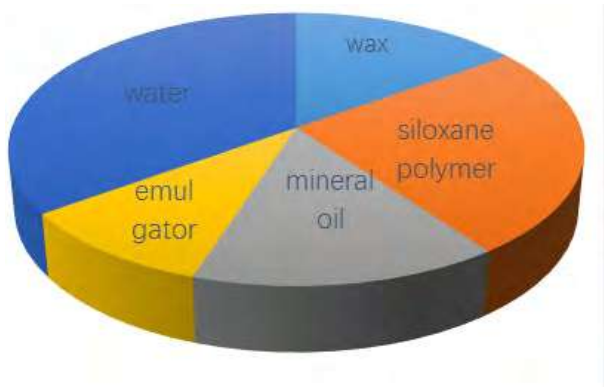

Fig4：the component of release

1.3 The performance of release agent

1.3.1The release agent properties

The release agent interact with mold directly, it produces an isolationlayer that can help the casting depanning. It contains water, wax, mineral oil, grease, silicon and some emulgator etc., the water can make the mold cool and as a carrier, wax can be a carrier and put the lubrication to spread out the mold, decrease the wetting angle,reduce the Leidenfrost effective(definition: the liquid can't wetting the high temperature surface, that just produce a steam layer) and can help the components to link:as a lubrication, silicon is very important,different style, different performance; the emulgator can promote the components to mix uniform, reduce the surface tension, it's very important for water-base. it has some effect that can emulsify, disperse, moistening, solubilizing, when stirring, it can make those organic solvent to become minuteness particle and suspend in water, finally, it become O/W stable emulgator.such fig 4.

The isolating layer produce some chemical and physical reaction when the liquid become solid, the release agent performance which reduce the solder defect is important if other processes are same.

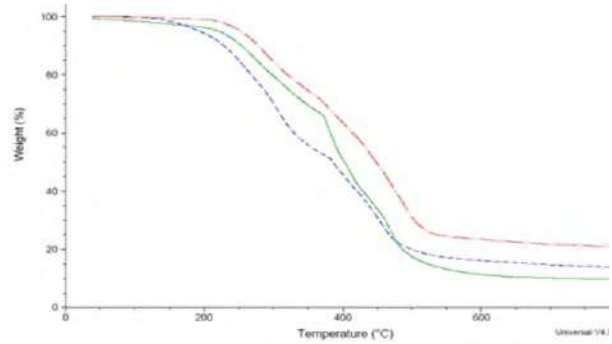

Fig5：TGA curve graph

Thermogravimetric Analysis(TG or TGA) is a technology which analyze the relationship of sample weight and temperature variation, it always be used for heat stability of material and components. Fig 5 displays three materials curve which effect of components are reducing when the temperature rising.

As the temperature rises, the slope of the curve is the largest. when the range is 200℃~400℃ at this time, the loss of the mold component is the most serious, as the temperature continues to rise, the curve region slows down this is the heat exchange interval between the mold and the metal liquid.You can see from fig.5,The high temperature resistance of release agent is red dot

line,it can prove that the release agent of red dots line is the best?

TGA curves of the best temperature range that mold temperature in 200°C ~ 300°C it can ensure that the metal liquid has good fluidity, and the property of lubricating is best. The high quality release agent can make the diluent of water-base evaporate very quickly. And not to increase the gas in the cavity, good affinity with mold,there is no accumulation,coated evenly;no corrosion, Good demulsifying effect,low COD, reduce environmental pollution sources.....

1.4 Die casting equipment and process parameters.

High speed injection can improve the filling capacity of the casting greatly, even some of the aggregated stomatal defects can be scattered, it's easy to solve some gas defect, the same to high pressure, It can make high density and good surface quality. and porosity or shrinkage defects can be reduced by high pressure to the range of process requirements, but it often brings more disadvantage, the joint flash is the most obvious type of defect.?such fig.6?it often causes difficulties when polishing and appear the surface layer of casting? beyond the specified range size?clean mold difficultly , the bonding force will raise between metal liquid and mold that produce solder defect?it greatly reduces the life of die casting machine.

Fig.6 the joint flash defect

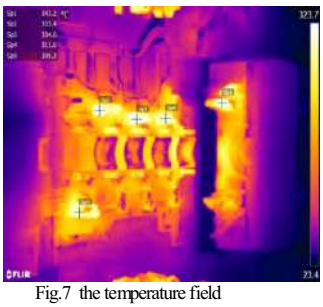

Fig.7 the temperature field

Solution of the solder

We can analyze some solder sources from die casting process and chemical principle.(Metal liquid characteristics, mold structure, release agent performance and other aspects), in production,according to the characteristics of the castings, the following aspects are explained in the following aspects:

Fig8: sp1 point of high-temperature solder

2.1 Reduce Aluminum temperature reasonably

From the first reason, we can find that the higher the temperature, the stronger the affinity of the Fe-Al, and the more obvious solder of the mold,fig. 7 displays the temperature field by infrared thermometer which factory produce cylinder block, the 5 points of icons are higher in temperature, and the corresponding solder defect are more serious. and the temperature from SP1 to SP5 is from high to low, and the degree of dolder is reduced,the five points are thicker, and the water cooling effect is relatively poor.fig. 8 is the degree which the SP1 temperature is the highest point of the casting.after adjusting the position of spraying and the time of spraying, the solder has been reduced much,I did the test which point cooling of mold at same process?,the water valve corresponding to the position of the solder near the ingate is tested in 3 styles, which are closed, semi open and full open. the results are as follows:

Water valve style	Mold temperature (after opening mold)	Product describe	Solder degree
Closed	390~400c	Serious solder and drop pieces often	1
Semi open	370~380C	Serious solder and drop pieces sometimes	2
Full open	320~330C	Solder little and drop pieces hardly	3
Definition?The solder degree is 1~4, 4 is the best, and the 1 is the worst. the press of water is 0.4Mpa			

After the normal production of the mold, the temperature is up to 200°C and not necessary to worry about the mold temperature is too low to cause the coating performance of the release agent,Therefore, the cooling water pipe is opened as much as possible, that reduce the surface temperature of the mold, and then reduce the reaction of Fe-Al interface, reduce the solder defect.

2.2 Selection of release agent and the way of spraying

Release agent is the important reason which effect the solder defect.it produces a film between the metal liquid and the mold. the performance of the film(extensibility, lubricity, high temperature resistance) directly determines the solder of the casting, when choosing the release agent, we can choose the well-known company as much as possible, which not only to ensure the stability of the product, but also to protect the mold.after long-term production, the surface of the mold is impregnated, and the corrosion of mold is reduced. once the poor quality release agent is sprayed, the 10% surface spots will appear in the short term, which reduce the surface quality of the mold greatly ,especially 3C products.

It's other important way is spraying,in order to improve the cycle, some manufacturers make some fix sprayed ,when opening it spraying immediately, and large atomization. At this time,the mold temperature is very high(above 350℃)when the mold surface temperature exceeds the Leidenfrost temperature (the wall temperature corresponding to the minimum heat flux in the droplet boiling curve), the solid liquid can't be directly contacted, and the vapor film is formed between the solid and liquid, and the heat transfer coefficient is much lower than that in the core boiling, in this way, a lot of release agents are wasted. When the mold temperature down to 200℃250℃A large number of effective components of release agent can be coated on the surface of the mold.The best spraying method is the phase spraying such from left to right and back?it can make release agent has sufficient time to attach to the surface of the mold, excessive or more time spraying doesn't effectively coated on the surface of the mold,On the contrary, the unattached components in the front were washed away by the spray behind,dilution ratio and spraying volume should be appropriate, if the release agent is high ratio or poor spraying ,it easy to make the thin film be crash and lead to solder.

2.3 Reducing the high speed and pressure reasonably.

In order to make the casting achieve a good surface and quality, many factories often use high speed and high pressure to produce defect, especially when shrinkage holes and blowholes are appeared. Not only can be solved by increasing pressure or speed. but also many solutions.Just only Increasing the pressure will produce solder defect and reduce the life of the mold and equipment, when the shrinkage cavity occurs, maybe it is caused by poor pressure. check whether the nitrogen cylinder pressure gauge is suitable, whether the aluminum liquid spectrum and density are in the process requirement range and so on...

2.4 Maintenance of mold

For nitriding molds, the polishing should be carefully ,and prevent the surface broken, Prevent the more polished and more solder. the tungsten carbide rod coating machine can be used for pouring parts or core of the ingate,on the surface of the mold, for EDM type metallurgical spraying tungsten carbide particle layer, tungsten particles and matrix metal binding and not falling off, it can improve the resistant solder performance on the mold surface, such as coating die surface layer deposited in 2~4μm, the hardness can get HV4000 ~ 4500, and max resistant temperature can reach 800℃ .

3. Summary

The solder has a great influence on the production and the quality. good gate system designing can improve the quality of casting. and use low mold temperature as far as the quality of the product is guaranteed(the mold temperature can't be too low, otherwise it will increase the tightening force and product cold lap defect), Low aluminum temperature, low speed and low pressure to produce, little solder needs polishing of aluminum polishing head or low hardness metal that prevent mold nitrided layer destroyed. good release agent and reasonable spraying process can increase the quality.

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Visit to Metal China Expo Beijing China, 2018 for Joint Ventures & Collaboration between CFA & PFA

Abdul Rashid,
Secretary-PFA

China-Pakistan Economic Corridor (CPEC) is a framework of regional connectivity. CPEC will not only benefit China and Pakistan but will have positive impact on Iran, Afghanistan, India, Central Asian Republic, and the region.CPEC is a journey towards economic regionalization in the globalized world. CPEC is a hope of better region of the future with peace, development and growth of economy. CPEC is a large-scale initiative to build energy, highway, and port infrastructure to deepen economic connections between China and Pakistan.

Mr. Wei Gao-Joint Secretary-China Foundry Association was specially invited to join us in 6th International foundry Congress & Exhibition (IFCE-2017) to strengthen our relation's for joint ventures and future collaborations. He invited PFA members to participate in "Belt and Road" initiative meeting &13th CFA Expo, 2017 in Shanghai- China and Mr. Asim Qadri joined them in this event. It was a good opportunity for both to understand and plan foundry growth in Pakistan with the support of Chinese foundries.

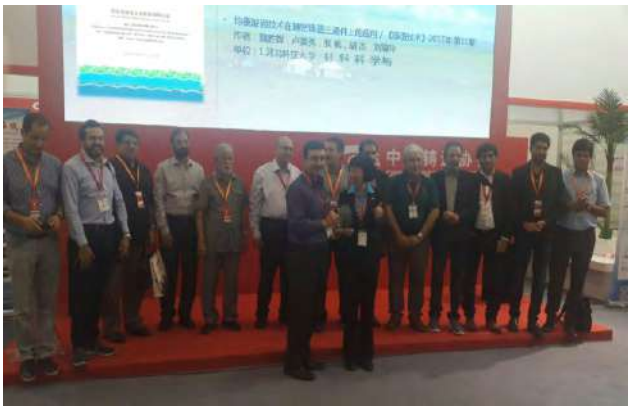
Metal China 2018 (the 16th China International Foundry Expo), sponsored by China Foundry Association, was held from May 16-19, 2018 in CIEC (New venue), Beijing, China.

A delegation of 25 members of PFA was formulated in the leadership of Mr. Asim Qadri again to participate in Metal China Expo, 2018 Beijing China. They visited Tianjin Foundry Industry to understand the possibilities of joint ventures with interested foundries. Chines companies have shown interest in infrastructure, energy as well as manufacturing industries. China can have joint ventures with local partners.

His visit was meaningful and have helped to build a path to sign a MOU for future cooperation and joint ventures between China Foundry Association and Pakistan Foundry Association. PFA is interested in technology up gradation of foundries in Pakistan and it will help in designing a strategy to work together.

Earlier PFA delegation was well received by CFA members and exchanged souvenirs. We are grateful to China Foundry Association for their warm welcome and hospitality.

Looking back in 2017, a lot of Chinese foundry companies were facing great difficulties under the pressure of environmental protection and safe production, however, the industry was still keeping a positive momentum. Metal China 2018 provided a lot of trade platforms to exhibitors and visitors, business connection, and also build a bridge for the world foundrymen to communicate, share experiences and resources, and establish relationships.



Pakistan Foundry Industry needs bold investments, which is not expected by the current players at the moment. Good opportunity and high time for foreign investors/companies to establish foundries in Pakistan. To fulfil the future demands of castings in Pakistan and to export Chinese & others giants are interested to invest with their strong footprints. China foundries investment in joint ventures with Pakistan foundries will create a win-win situation.

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Manufacturers of Medium Frequency Induction Melting Furnaces

Custom made foundry solutions

Flexible design to match your foundry reqirements

Motor Generator upgrade solutions to Solid State Furnace

Made In Pakistan

Based on latest technology

Melting Capacity

Steel Frame Crucible: 10MT to 50MT

Yokeless Aluminum Crucible: 50kg to 10MT

Power Pack

Series Inverter: 50 kW to 900 kW

Parallel Inverter: 50 kW to 14000 kW

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10km, Gujranwala-Lahore G.T Road, Attawa, Gujranwala Pakistan

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Phone: +92 55 34000505

Fax: +92 55 3264490

Email: electroheat@gmail.com | mnubeg@gmail.com

Website: www.electroheat.com.pk

Among our prestigious customers:

Bolan Castings Ltd, Karachi

Chenab Engineering Works and Foundries (Pvt) Ltd, Faisalabad

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