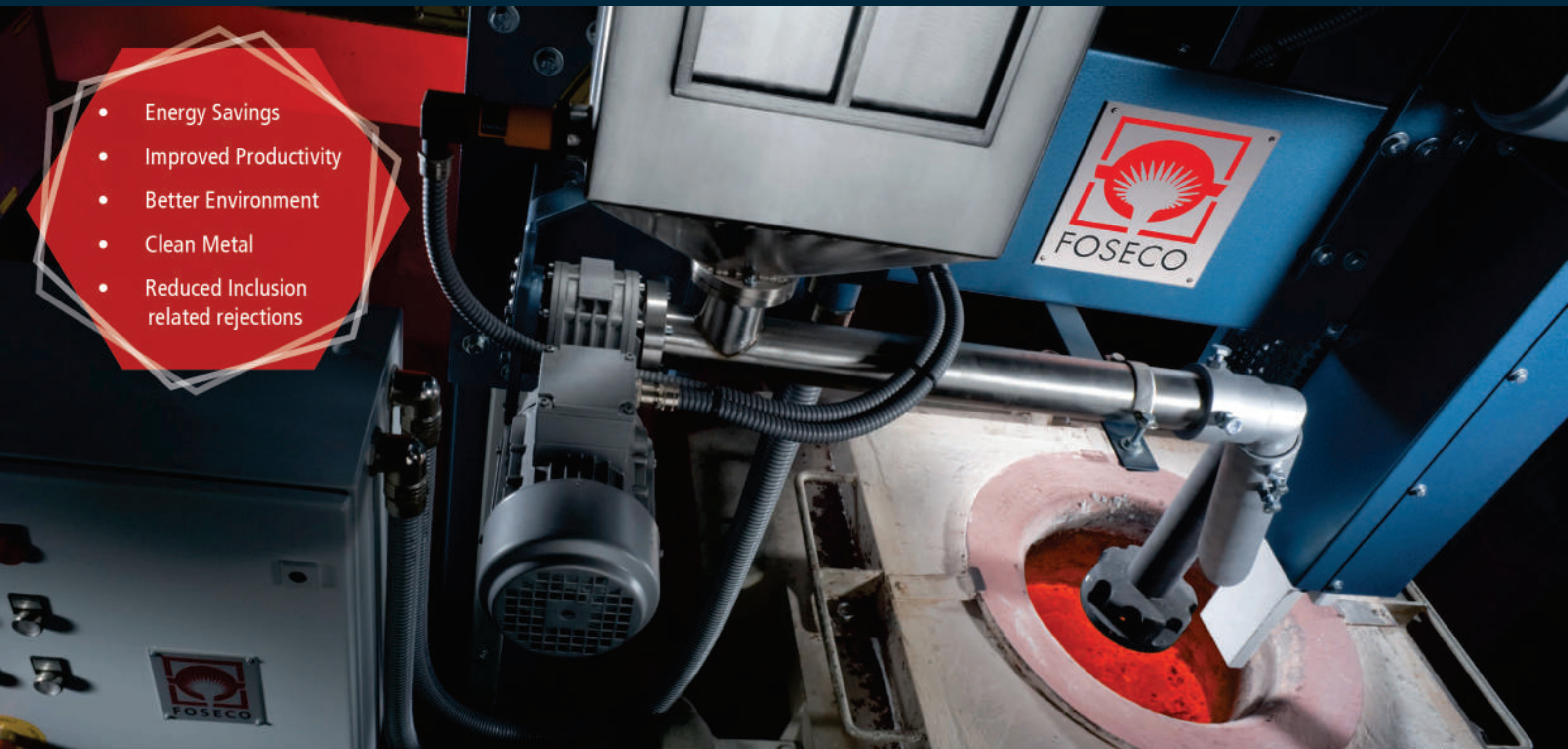
ALUMINIUM GDC TECH
GREAT DIE CASTING

GREAT DIE CASTING TECHNOLOGY FORUM

JOURNAL FOR ALUMINIUM CASTING TECHNOLOGY

Volume 56 - February 2023



Forace Group

Latest Global Technologies and customized solutions for defect and cost reductions

Long Life High Technology Die Coats for LPDC and GDC from John Winter, U.K.

- Highly insulating Long life die coat
- Control the metal flow and heat transfer
- Minimum touch up required
- Provide insulation enabling control of cooling and solidification
- Textured to enable enhanced metal flow reducing cold shuts and entrapped gas
- Removes shrinkage defects from castings, gives excellent surface finish

High Performance HPDC Lubricants from JODOVIT, Italy

- Eases the casting release, produce clean and bright castings.
- Protect against soldering of aluminium on the die steel.
- Support the post cast process like painting and coatings
- Eliminates corrosion of the mold surface

Boron Nitride Coating

- BN H20 from John Winter, U.K
- VERNIX SCHELL X BN 33 from JODOVIT, Italy

- **Granulated fluxes**
- **Powder fluxes**
- **Degassing and Grain refining tablets**
- **Master Alloys**
- **Ladle coats**
- **Degassing and Flux Injector machines**
- **Advance Refractory products from Carborundum Universal Limited (CUMI), Mumbai**

FORACE GROUP

10th K M Stone, Haridwar-Delhi Road
Haridwar 249402, Uttarakhand, India

Tel: +91-1334-334000, +91-9068907918 / 9068907917

Email: mktg@foracepolymers.in
www.foracepolymers.net

Volume 56 - February 2023

ALUMINIUM GDC TECH
GREAT DIE CASTING

Contents

Dear Readers,
We always look forward to your Feedback and comments on the Journal. Please do write to us.

GREAT DIECASTING TECHNOLOGY FORUM

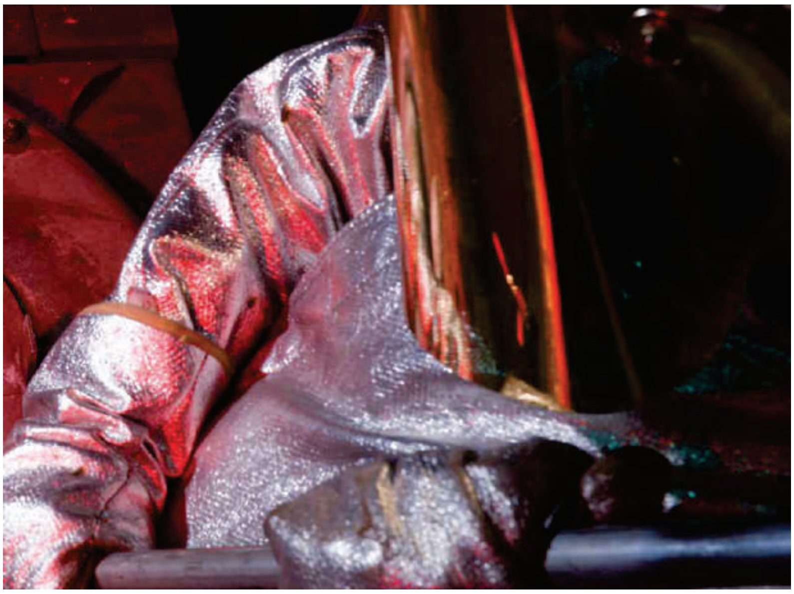
'Guruprasad', 1st Floor, 37/4/A, 6th Lane, Prabhat Road, Pune 411 004 INDIA
Tel: +91 20 2567 0808, 2567 2555 | Mobile: +91 9764711315
gdctech@arkeycell.com, arkeyconference@arkeycell.com
www.gdctechforum.com

Note: Some images in some articles may not be clear. Interested readers may contact the author

THEORY AND PRACTICE OF GRAIN REFINING FOR ALUMINIUM ALLOYS - UTILIZING COVERAL MTS 1582

Authors: Brian Began, Foseco USA & Pascaline Careil, Foseco Europe

The need for smaller grains is vital to achieving the required properties when pouring most cast aluminum alloys. Whether the desired results are high mechanical properties, leaker free castings, a cosmetic appearance or improved structural soundness, smaller grains are impactfully beneficial. Accordingly, there is a desire to improve both grain refining and the ability to quickly and effectively assess grain refinement effectiveness. This paper discusses both the need for smaller grains and the principle fundamentals of grain refining. Moreover, the paper reviews commercially-available grain refiner forms and currently available methods for assessing grain refinement. Finally, the paper introduces a new and improved flux form grain refiner (COVERAL MTS 1582) and documents two recently successful case studies where the COVERAL MTS 1582 was utilized to improve castings in both a low pressure wheel foundry and a high production sand moulding foundry, respectively.



INTRODUCTION

Grain refining is an essential part of the aluminium casting process which aims at reducing the size of primary aluminium grains during the solidification phase. This process has many benefits for most hypoeutectic aluminium alloys as it improves feeding, elongation and mechanical properties, increases resistance to fatigue, improves casting machinability, reduces hot tears, helps disperse micro-shrinkage, decreases the size of porosities and reduces thermal treatment cycles. Historically, grain refinement has been achieved using master alloys, with the most commonly used grain refiner mechanism involving the release of Titanium diboride into the melt. Grain refining is especially important in aluminium foundries using investment, sand, gravity die, or low pressure die casting processes due to the potential for delayed cooling and complex casting designs with varying section thickness.

In general, those castings with slower cooling rates and larger variation in casting thickness, require grain refinement more than other casting designs.

There are several casting segments where grain refining is critical including:

+ Wheel foundries where grain refinement and cleaning are crucial for achieving the required feeding and cosmetic surface finished of the casting.
+ Safety critical automotive castings such as suspension parts, turbochargers, and brake components which require good fatigue properties.
+ General automotive castings like cylinder heads, engine blocks, manifolds in gravity diecast where an intermediate level of grain refinement might suffice for the mechanical property requirements, but the improved feeding from grain refinement helps prevent leakers.
+ Aerospace and military castings requiring high mechanical properties for difficult applications, grain refining is highly beneficial.
+ Sand and investment castings where the long solidification times cause large grain growth and difficult feed paths without optimized grain refining.

GRAIN REFINEMENT MECHANISM IN ALUMINIUM ALLOYS

TARGET OF ALL MELT TREATMENT PROCEDURES IS AN IMPROVEMENT OF MECHANICAL PROPERTIES

Grain refinement affects the α-mixed crystal in the alloy. At decreasing temperature those α-mixed crystals grow. Grain size depends on cooling rate during solidification. The addition or formation of nuclei increases solidification speed and decreases the grain size.

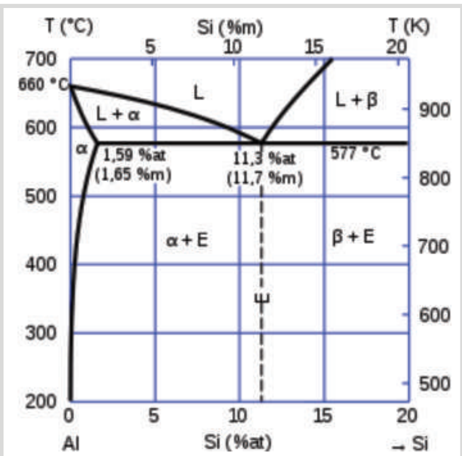


Figure 1: Al-Si phase diagram

Ceramic	Angle
TiB_2	60°
ZrB_2	106°
HfB_2	134°
TaB_2	125°
TiC	118°
ZrC	150°
SiC	135°
HfC	148°
NbC	136°
TaC	145°
TiN	135°
ZrN	167°
NbN	156°
AlN	138°

Table 1: Contact angle of different ceramic materials [1]

MASTER ALLOY AND CHEMICAL PRODUCTS COMPARISON

Considerations when using master alloy grain refiners

+ AlTi5B1 - AlTi3B1 - AlTi5B0,2 - AlTi10B1
+ TiB_2 nuclei are pre-formed in an aluminium matrix
+ Easy to apply
+ Risk of oxides or impurities in the rod or waffle
+ Moisture and oxides on rod surface contaminate melt

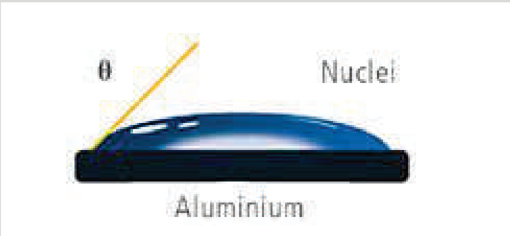


Figure 2: Nuclei needs a good wettability by melt

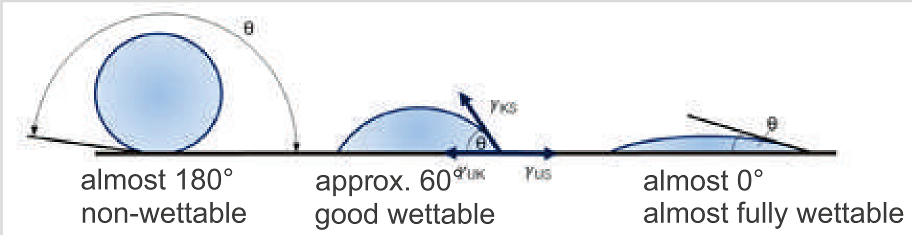


Figure 3: Heterogeneous nucleation as a function of wetting angle

$$\sigma_{\alpha F} = \sigma_{\beta F} + \sigma_{\alpha\beta} \cos(\theta)$$

$\sigma_{\alpha F}$ = melt surface energy
$\sigma_{\beta F}$ = surface energy of nuclei
$\sigma_{\alpha\beta}$ = interface energy between nuclei and melt

Figure 4: Young's equation

Benefits of chemical products are:

+ Contain metallic titanium and boron salt or titanium and boron salt
+ TiB_2 nuclei are in-situ formed in the melt – fresh surface – higher surface energy and lower θ angle
+ No risk of impurities
+ Additional cleaning effect

REASONS FOR BETTER MECHANICAL STRENGTH WITH CHEMICAL PRODUCTS

We identified several reasons for archieving better mechanical strength with chemical products which are:

+ Chemical products and master alloys with pre-formed nuclei impact the contact angle θ differently
+ θ for TiB_2 = 60° is a theoretical value for an ideal nucleus
+ θ for TiB_2 from master alloys is significantly higher due to reduced surface energy
+ θ for TiB_2 from chemical products is close to 60° or even below due to fluxing effect from chemicals (fluorides)

COVERAL MTS 1582

FOSECO has developed a novel granulated flux COVERAL MTS 1582 that is capable of both grain refining and cleaning aluminium alloy melts. COVERAL MTS 1582 is highly concentrated in titanium and boron which form both titanium diboride and aluminum boride in situ leaving fresh nuclei within the aluminium melt. These finely dispersed species are highly efficient nuclei that promote a fine equiaxed grain growth during solidification.

In addition to strong grain refining, COVERAL MTS 1582 fluxis also a very good cleaning product that will react to remove oxides and inclusions from the melt. No additional cleaning/drossing flux is required, resulting in lower overall process costs.

COVERAL MTS 1582 is a sodium- and calcium-free granulated flux suitable for all types of aluminium alloys except hypereutectic alloys but including those alloys containing large amounts of magnesium.

APPLICATION OF COVERAL MTS 1582

COVERAL MTS 1582 is specially designed for use with FOSECOs MTS 1500 rotary degassing and melt treatment equipment, whereby controlled flux additions are made directly into a melt vortex and mixed vigorously. PLC controlled additions of the treatment flux are added into the vortex and mixed to complete reaction prior to the vortex breaker baffle board re-engaging the melt, effectively stopping the vortex. After the vortex has been stopped, the MTS completes a standard rotary degassing process and the treated metal in the ladle or crucible is used for transferring and/or casting.

For further information of the MTS 1500 process, readers are advised to review Foundry Practice Issue 247 (2007) or the Foundry Practice Special Edition for AFS CastExpo (2008).

Both issues feature excellent articles on the MTS 1500 technology [References 2 and 3].

MTS 1582 should be used with the melt at a temperaturehigher than 720 C. The reaction by-product from this treatment produces an extremely dry ash-like dross that is easily separated from the liquid metal with a coated skimmer or similar tool.

EVALUATING GRAIN REFINEMENT EFFECTIVENESS

Since grain refinement is critical to achieve the desired properties of aluminium castings, it is important that there are methods for assessing grain refinement effectiveness. The most common methods for evaluating grain refinement effectiveness are as follows:

+ Elemental spectroscopy
+ Thermal analysis
+ Microstructural evaluation

ELEMENTAL SPECTROSCOPY

Elemental spectroscopy is perhaps the most commonly
employed method for assessing grain refinement, but it is also the least effective of the three methods listed.

Spectroscopy only determines the total concentration of an element - however Titanium is usually present in other forms and phases in addition to TiB_2 and these other phases do not impact grain structure. Foundries will measure Ti into the alloy range (typically 0.10-0.25% by weight) and assume that because they are in range, they are achieving sufficient grain refinement. Consequently, given this issue, some foundries will also measure boron (typical range 5-25ppm) as an additional control. Tight controls of Ti and B do typically result in effective grain refining; however, more advanced methods like thermal analysis and microstructural analysis ensure higher probabilities of optimized grain refinement.

THERMAL ANALYSIS

Thermal Analysis is perhaps the fastest growing method for assessing grain refinement as it is quick and more accurate than elemental spectroscopy. The THERMATEST* 5000 NG III (pictured in Figure 5) is a widely used thermal analysis unit used to quickly and accurately assess grain refinement effectiveness in aluminium alloys. Thermal analysis involves collecting data of temperature versus time of a solidifying melt sample and comparing the curve to a set of known reference curves algorithmically. The THERMATEST 5000 NG III unit's algorithm analyzes the sample curve liquidus and computes a score on a scale from 1-9 for evaluating grain fineness (GF). A score of 1 references a curve that compares with curves exhibiting no grain refining.

In contrast, a GF score of 9 is achieved when the sample curve compares with those curves known to have produced "perfect" grain refining of melts with the same alloy composition. A pictorial representation of the THERMATEST 5000 NG III grain refinement levels is provided in Figure 7. Of note, THERMATEST 5000 NG III unit also provides the side benefit of helping to assess eutectic modification effectiveness in Al-Si alloys [References 4 and 5].

EVALUATION OF GRAIN SIZE WITH THERMAL ANALYSIS

For a given cooling speed, the size of the grain depends on the amplitude and duration of the undercooling, which appears at the formation of primary aluminium crystals.

+ When the undercooling is high and duration medium
  (Fig 6a), grain size is coarse.
+ When there is no undercooling (Fig 6b), grain size is very fine.
+ When undercooling is low but duration is high, the grain size is very coarse.

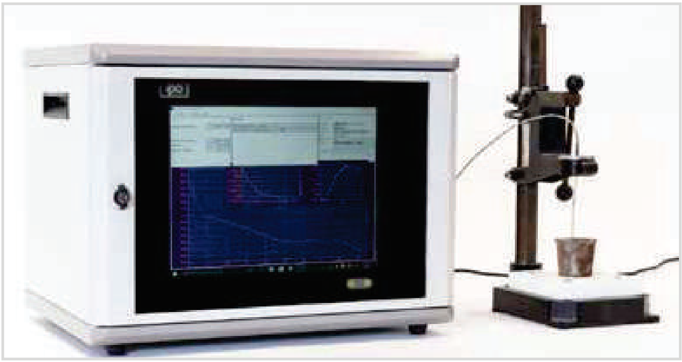
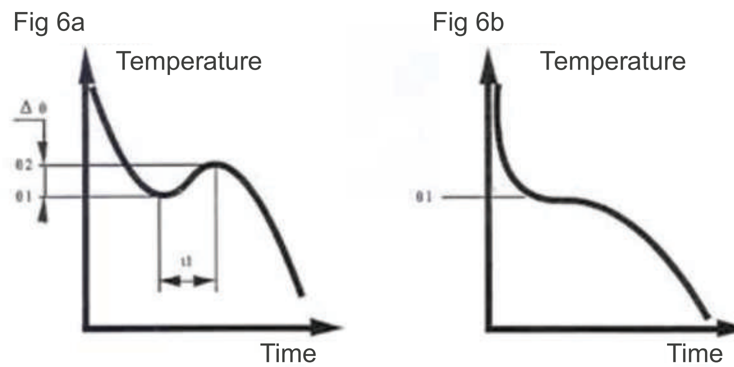


Figure 5: Photograph of a THERMATEST 5000 NG III unit

THERMATEST 5000 NG III measures the following Liquidus
parameters:

+ Temperature θ2 (°C)
+ Undercooling Δθ(°C)
+ The duration of undercooling t1 (in seconds)



θ1: Temperature at which the solidification begins
θ2: Maximum temperature reached at the end of undercooling
Δθ: Apparent undercooling equal to θ2-θ1
t1: Duration of undercooling

Figure 6a and b: Profiles of the cooling curve at the solidification of primary aluminium crystals in case of hypoeutectic alloy

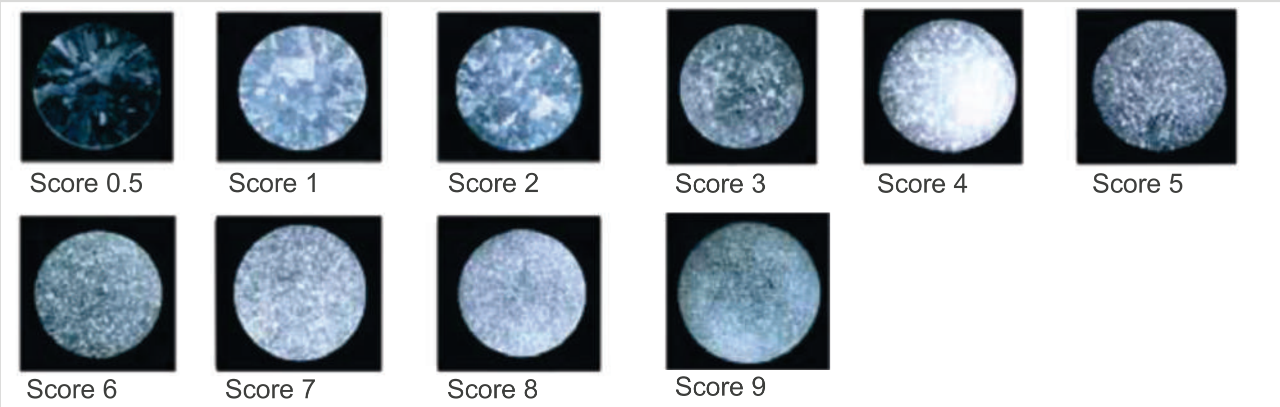


Figure 7: Test of grain refinement - Standard plate with Grain Fineness (GF)

Grain refinement is considered fully optimized when the undercooling is nil and grain size index is equal to 9. However, for certain alloys and thin shaped castings in permanent moulds, a lower grain size index (5 - 9) would be expected and is acceptable due to the higher cooling rate with permanent die casting.

We recommend setting a minimum grain size index for each casting, correlated with desired elongation of mechanical properties. For Al-Cu5%MgTi alloys, the absence of undercooling may not be sufficient to avoid hot tears. A stronger grain refinement is recommended to improve the alloy's performance.

LIQUIDUS CURVES: COMPARISON OF TIB RODS WITH COVERAL MTS 1582

The lower the undercooling at Liquidus, the stronger the grain refinement. COVERAL MTS 1582, at much lower addition rate (0.11 % vs 0.2 % for AlTi5B1 rods), performs better compared to AlTi5B1 rods.

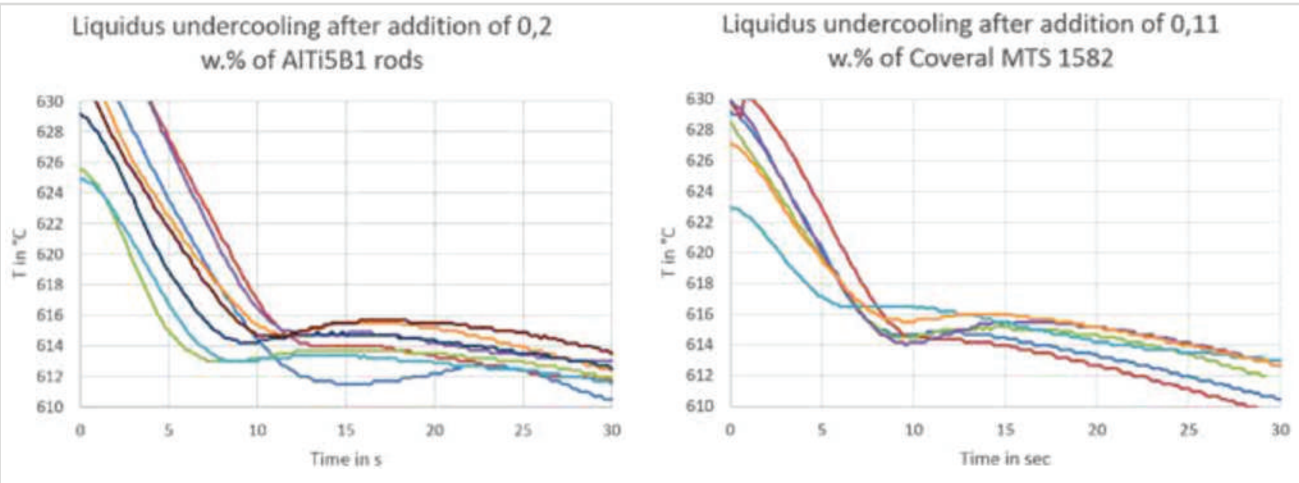


Figure 8: Thermal analysis curves

OPTICAL MICROSCOPY (BARKER TEST)

Optical microscopy is the final methodology employed by foundries to assess grain refinement. Optical microscopy is considered the most representative method for assessing grain refinement but is time-consuming and resource intensive. Optical microscopy involves grinding and polishing test specimens to microscopic levels to be evaluated for grain size under a microscope. One popular method for optical microscopy is the Barker test. The LectroPol-5 from Struers is used for electrolytic etching with Barker reagent consisting of a 5% tetrafluoroboric acid in distilled water. The sample to be tested acts as an anode in a galvanic cell, which removes material from the sample surface and an anodic layer can be formed. With the Barker method, under a polarized light, a colored representation of the grain structure of aluminum materials is achieved. It is possible to carry out microscopic testing with up to 1000x magnification.

Alloy: AlSi7Mg0,3
COVERAL MTS 1582
Addition rate: 0,1%

Figure 9a: Before treatment. Grain size dm [µm] = 984

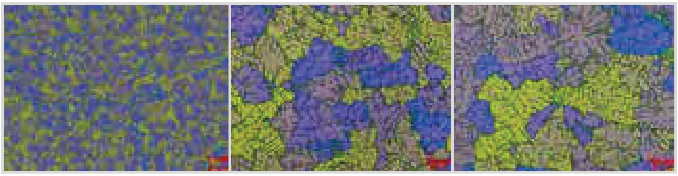
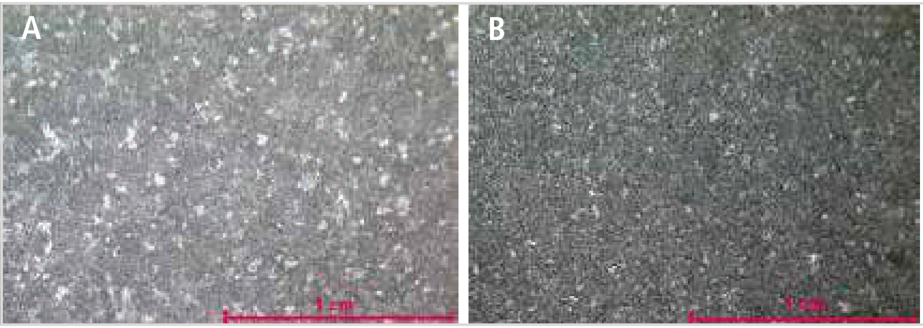


Figure 9b: After treatment. Grain size dm [µm] = 206



A Alloy: AlSi7Mg0,3
Rods AlTi5B1
0.08 % addition rate
Grain size Ø = 422 µm

B COVERAL MTS 1582
0.05 % addition rate
Grain size Ø = 237 µm

Figure 10: Comparison of TiB rods with Coveral MTS 1582: grain size

CASE STUDIES

WITH COVERAL MTS 1582

1: European foundry

A European wheel foundry was interested in improving its melt treatment practices by utilizing COVERAL MTS 1582 with a FDU featuring MTS 1500 technology. This wheel foundry pours a standard AlSi7Mg alloy and historically performed grain refining by making manual additions of TiBor rod into a transfer ladle during degassing. It was the foundry's target to automate the grain refining process all while capturing the typical benefits (drier dross, lower spend, smaller grain) achieved when grain refining with COVERAL MTS 1582. The treatment parameters of the new process featuring COVERAL MTS 1582 can be found in Table 2.

After the new process grain refining with COVERAL MTS 1582 was implemented, pictures were taken of the ladle dross (Figure 11), thermal analysis curves (Figure 13) and microstructures (Figure 12).

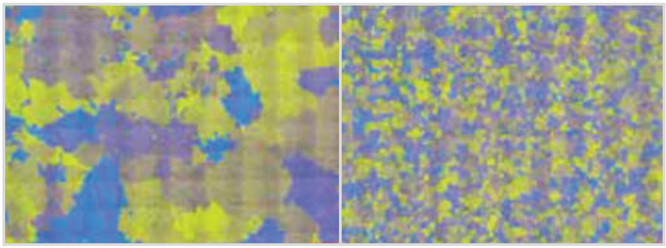


Figure 12: Microstructure before and after treatment with COVERAL MTS 1582.

Treatment parameters	
Ladle	INSURAL ATL 600 with 500 kg of AlSi7Mg
Temperature	730 - 760 °C
Addition rate	250 g COVERAL MTS 1582 (0.05 % of the melt weight)
Treatment time	6 minutes
Inert gas flow	20 l/min N_2
Rotor speed	450 rpm for MTS FDR 190.70

Table 2: European Wheel Foundry (EWF) treatment parameters.

Figure 11: Photograph of extremely dry dross in transfer ladle after treatment with COVERAL MTS 1582.

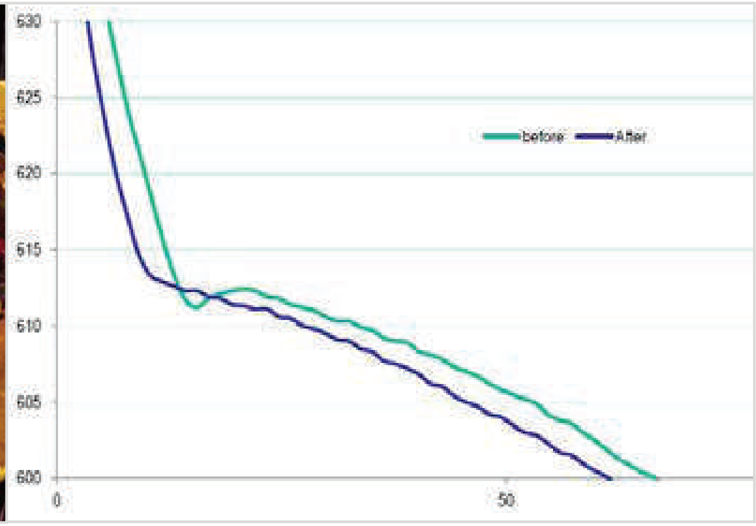


Figure 13: Thermal analysis curves

2: American foundry

Littlestown Foundry is a sand and low-pressure (LP) mould aluminium foundry in Littlestown, Pennsylvania in the USA. The main alloy poured by Littlestown Foundry is a standard 356 alloy (AlSi7Mg). In the sand foundry, Littlestown casts some difficult castings that are subjected to pressure testing with air to make sure they are leak free for application. After reducing scrap through improved grain refining in the LP foundry from 13.6% to 2.7% by converting from metallic TiBor (10%Ti, 1%B) to COVERAL MTS 1582, a similar project was undertaken in the sand foundry. The aim was that by improving the grain refining using COVERAL MTS 1582 - introduced via an MTS 1500 unit - in place of metallic TiBor rod, the sand foundry would see similar benefits in the form of reduced leakers and lower spend.

The first part of the project involved using a THERMATEST 5000 NG III unit to assess the incumbent procedure and then developing an optimized procedure using the MTS 1500 and COVERAL MTS 1582. The results of the THERMATEST 5000 NG III evaluation are presented in Table 3.

Sample #	Average Grain Fineness (GF)
Sample before treatments	5.8
Standard TiBor Additions	6.8
COVERAL MTS 1582	9.0

Table 3: Results of THERMATEST 5000 NG III evaluation with the COVERAL MTS 1582 grain refining flux.

The THERMATEST 5000 NG III evaluation confirmed that the metallic TiBor rod was successful in raising the Grain Fineness value from insufficient (5.8/9.0) to an improved and more acceptable level of grain refining (6.8/9.0). However, the THERMATEST 5000 NG III unit also confirmed that a huge improvement to a fully optimized level of perfect grain refinement (9.0/9.0) was possible with the COVERAL MTS 1582. Hence, mechanical test bars were poured and evaluated to assess any potential impact of the new process featuring the COVERAL MTS 1582.

The results of the mechanical testing evaluation are shown in Table 4. The results exhibited positive improvement in all three metrics evaluated, i.e., ultimate tensile strength (UTS), yield strength (YS) and % Elongation. Accordingly, the decision was made to convert to the new process to make a full assessment of the new process featuring COVERAL MTS 1582 and a FDU featuring MTS 1500 technology.

Test	Incumbent TiBor Process	New Process Featuring MTS 1500 & COVERAL MTS 1582
UTS in psi (MPa)	40,000 (276)	41,290 (285)
YS in psi (MPa)	34,500 (238)	35,100 (242)
Elongation (%)	4%	5%

Table 4: Results of mechanical testing of preceding treatment samples and samples collected after the implementation of a MTS 1500 with COVERAL MTS 1582.

Finally, after four months in production, the new process change was evaluated economically. The following economic benefits were achieved after implementation:

+ Reduction in annual projected spend on grain refiners and cleaning flux by $276 per day, $1,380 per week, $5,750 per month or more than $69,000 per year.

+ A ten-fold reduction in projected impregnation costs from a starting point that exceeds $1,500 per month to less than $150 per month.

+ The calculated payback for the MTS 1500 unit when
factoring in the lower grain refining spend, the lower flux cleaning flux spend and offsetting it with the slightly
higher spend on filters is just over 6 months.

A full peer-reviewed paper (paper #19-015) on the Littlestown Case Study was published with the AFS 123^{rd} Metalcasting Congress Proceedings in April 2019 and is available for a more extensive review.

REFERENCES

1. G. Samsonov, A. Panasyuk und G. Kozina, Poroshkovaya Metallurgiya, Nr. 11, pp. 42-48. (1971)
2. Careil, P., & Simon, R. MTS 1500, Automated Metal Treatment Station.
   Foundry Practice Issue 247. p. 15-20. (June 2007)
3. Careil, P. & Simon, R. MTS 1500, Automated Metal Treatment Station.
   Foundry Practice Special Edition for Cast Expo 2018. p. 1-6. (May 2008)
4. Stonesifer, J. & Began, B. Degassing and Flux Grain Refining in a Continuous Well at Littlestown Foundry. AFS 123rd Metalcasting Congress Proceedings. Atlanta, GA : American Foundry Society. (2019)
5. Careil, P., & Kientzler, P. Thermatest, 5000 NG III: thermal analysis equipment designed to predict and control the structure of aluminium alloys before casting. Foundry Practice Issue 250. p. 2-6. (September 2008)

SUMMARY & CONCLUSIONS

COVERAL MTS 1582 is a universal grain refining and cleaning flux for treating aluminium alloys. It forms in situ Aluminium boride and Titanium boride which are the most suitable nuclei, within aluminium melts. Creating TiB2nuclei in situ is more effective than releasing pre-made TiB_2nuclei into a melt. Elemental spectroscopy, thermal analysis with a THERMATEST 5000 NG III and optical microscopy are three methods for assessing grain refinement effectiveness within a melt; the latter two methods being the most efficient. Experience in both a low pressure wheel foundry and high production greensand foundry has confirmed the benefits of superior casting mechanical properties and lower overall process costs when grain refining using COVERAL MTS 1582 through an MTS 1500 unit.

CONTACT

PASCALINE CAREIL
EUROPEAN PRODUCT MANAGER NFMT

pascaline.careil@vesuvius.com
+33 6 23 17 02 25

BRIAN BEGAN
APPLICATION MANAGER NFMT

brian.began@vesuvius.com
+1 440 863 2755

AFECO HEATING SYSTEMS, Kolhapur, Maharashtra, India.

Bureau of Energy Efficiency
Ministry of Power, Government of India

The event was held at Vigyan Bhawan, New Delhi and was graced by the presence of Hon'ble Madam President Smt. Droupadi Murmu as the Chief Guest.

On behalf of AFECO HEATING SYSTEMS, the award was received by their Managing Director – Mr. Prakash Maladkar and Marketing Manager – Ms. Shivranjani Maladkar. The award was distributed by Hon'ble Shri R. K. Singh, Cabinet Minister – Ministry of Power, Government of India.

Porosity in ALuminium casting

C. Surianarayanan - Consultant, Email : c.surianarayanan@gmail.com

Internal Quality issues in aluminium casting and the reasons for it to be caused

Impregnation of aluminium castings for leak stopping is still considered the best option

Want to develop a method of improving faith in Aluminium high pressure die casting pressure tightness then it is better to concentrate on the details mentioned below.

Pressure die casting:

It has two basics in built by the process:

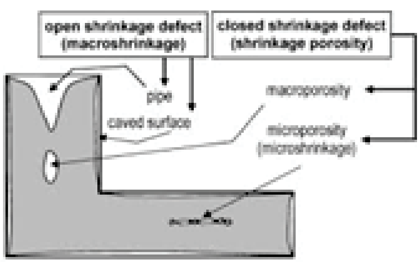
Toughness by work hardening due to the high-pressure injection and filling

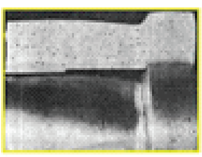
Packed tight with high velocity o that structure is clean with no deviations

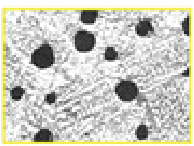
Porosity is caused by the absorption of nitrogen, oxygen and hydrogen in the molten weld pool which is then released on solidification to become trapped in the weld metal. Nitrogen and oxygen absorption in the weld pool usually originates from poor gas shielding

But This can be damaged due to the reason:

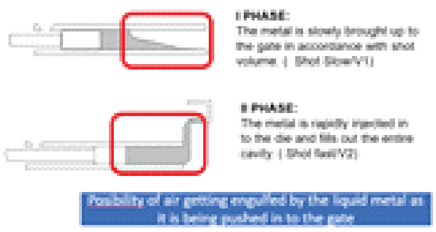
Product design with uneven section thickness which is not accommodable to flow the liquid alloy to get the part filled with packing against the shrinkage happening during the solidification. Shrinkage is an internal or external change in volume that occurs during a phase change in a metal's transition from a liquid state to a solid state at the exposed surface. This phenomenon occurs in processes like casting and concrete solidification

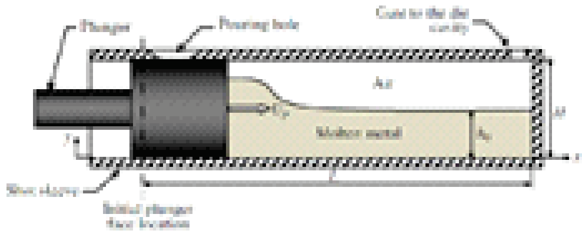




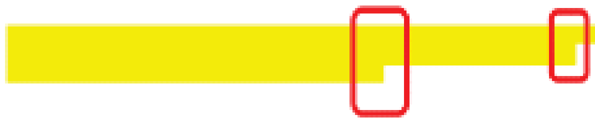


Air getting engulfed during the liquid alloy is getting compressed in the cold chamber before being pushed into the profile areas





Runner passages which are having stepped formation which can add void during the turbulence happening during the flow of the liquid alloy through the runner passages



Flow is disturbed by the sudden steps as marked and will create turbulence there by causing void in the liquid metal as it flows in to the profile

Flow is not disturbed and a smooth flow of the liquid metal is taken smoothly to the gate locations

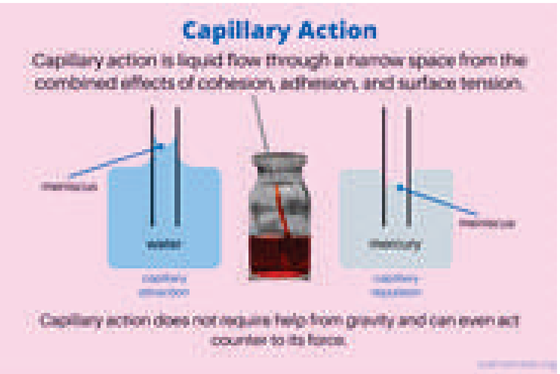
Improper selection of the fill ratio which can cause filling defects there by voids and shrinkage can happen

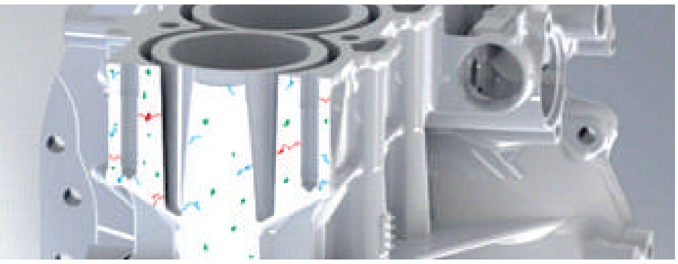
Air entrapment during the flow of the liquid alloy into the die from the runner to the final filling area of the profile can cause the internal gap in the profile sections

All these are the very basic but not taken into consideration during the Stages of Product design, Die engineering and the Process methodology

When there is an issue of void /shrinkage/ air entrapped in the casting it can lead to leak if the part is subjected to such applications. Where there is heat in the part due to the operational need's aluminium expands to the best possible.

This will create gap in the molecular and the expansion will lead the void to get the substance to leak out due to the capillary action





How do you reduce the porosity of aluminium casting?

Gas porosity can be eliminated **through good mold design or by introducing nitrogen into the aluminum metal before the liquid pour.**

Apart from these pints what are the other influential aspects that can cause the internal quality or the soundness of the casting results:

Thermal regulation of the die and the liquid metal has the highest degree of influence or effect on the filling pattern, packing pattern of the liquid metal.

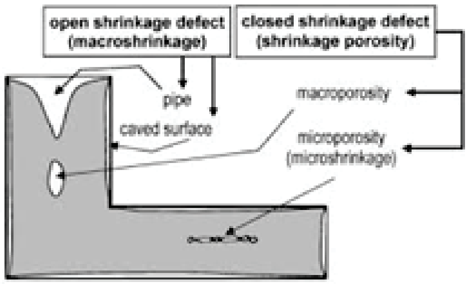
What is the best of the temperature for the alloy and the die?

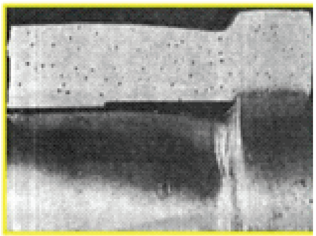
Alloy: Clean alloy with 650°C to 680°C maintained in the holding furnace will be the best. Because alloy temperature gets reduced in the transferring movement by the ladle from the furnace to the pouring spout of the shot sleeve. This is in regards with the conventional arrangement.

In the place of the dossing furnaces, it can be well within 650°C. Here the liquid metal transfer is happening in a closed passage and not transferred in the open air there by temperature loss is less anticipated.

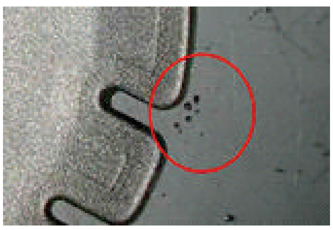
How can the temperature of the alloy influence or cause the probable internal defects?

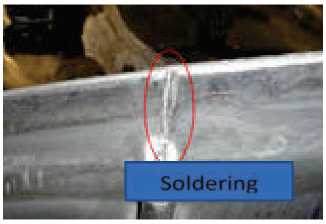
Suppose the temperature is higher, then the liquides flow is faster than the solidus condition. This will flow the liquid metal faster to the profiles but before it is getting packed it may freeze on the areas where solid sections are to be filled with packing to avoid internal shrinkage porosity as shown in the sketch





If the temperature of the liquid metal is lower than the prescribed suggestions, then the flow will not be /may not be effective and likely chances of layer formation is possible. In this situation also liquid metal at a lower temperature may not flow to pack the part profiles. This will cause the internal quality issues like shrinkage, laminar flow etc.





Thermal managemnet of the cold chamber has its own ifluence on the liquid metal temperature. If the chamber is not maintained with the temperature of approximately 180°C to 250°C. It will draw the temperature of the molten alloy poured in to the chamberand reduce the alloy temperature. Hence its is suggested to have the water channels in the cold chamber and temperature be managed to the needs. Lower temperature of the liquid alloy will have iues with low silicon& higher ferrus content alloys.

How die coat water spray has the ifluence for this cause?

Earlier days oil or oil based coating was used just to protect the stesl being thermaly abused by the high temperature liquid metal being puhed with high velocity. Reaearchers say it goes anything up to 700°C as the metal squeezes through the gate. Even if the die is hot enough to with stand the enhanced heat generated by each shot, it has to be controlled as well the steel has to be protected. Hence this water based soluble was invented and being ued till date.

Spray technique is related to the spray pattern , volume of water sprayed and ubsequent dry air being sprayed. There are likely chances of water getting stagnated in the profile pockets hence dry air spraying is recomanded for pushing the water out of the die and have the protection coating is there on the steel.

Supposing water is sprayed high then there are chances for the stagnation as well the die temperature being disturbed. This waill cause solidification defects, flow defects and stagnated water can explode by the hot alloy and gas can be formed which will get in to the casting profiles.

Buhler training teach the spray techniques along with the time line of the water as well the dry air. It is very clear that this also can cause the internal defects in the casting leave apart the other details such as runner, gate , temperature etc.

These are just a glimpse on the experinces has in all these years. It may not be scietific but true practical experience shared for the betterment of the future diecasters.

R. T. Kulkarni along with Mr. R. V. Apshankar visited Neo Wheels, Nashik

Brain Storming Meeting with Advisory Committee

ENERGY SYSTECH

ALUMINIUM FURNACES

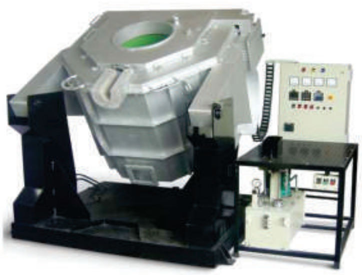
Sklenar-type Melting Furnace

"Bulk Melting solutions"

Salient Features:

- Rugged construction with smooth & jerk-free tilting.
- Efficient combustion system.
- Easy charging of material into the furnace.
  Manual or Skip Hoist type.
- Easy dross cleaning.
- Long refractory life.
- Rapid & economical melting.
- Low melt loss.

Electrical Stationary Furnaces



Electrical Hydraulic Tilting Furnaces

Nitrogen Degassing Machine (auto)

Density Index Unit

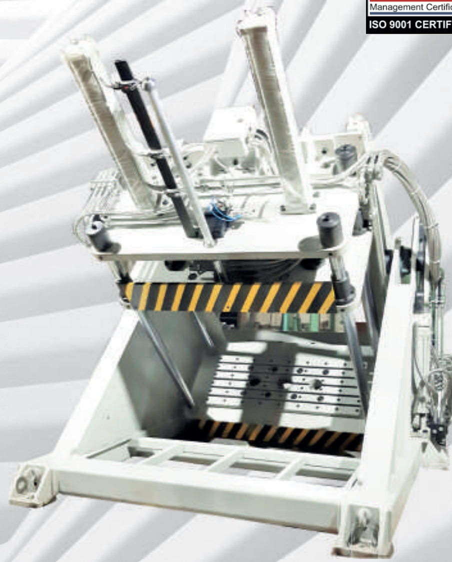
Other Products for the Aluminium Industry

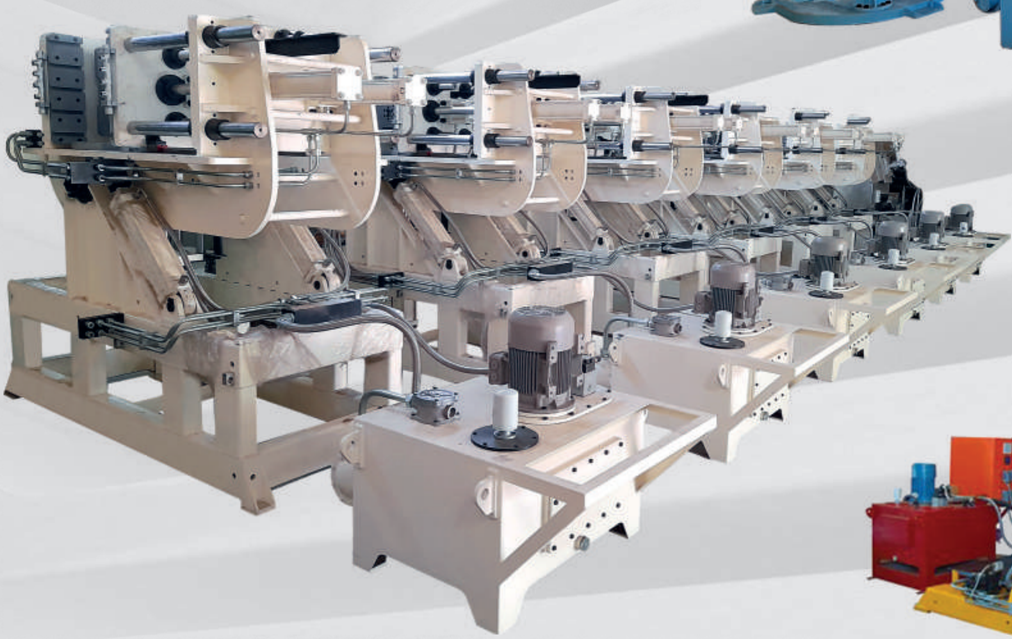
- Electrical Furnaces (Crucible)
- Fuel Fired Furnaces
- Electrical & Fuel Fired Tilting Furnaces
- Heat Treatment Furnaces
- Rotary Degassing Unit
- Density Index Unit

ENERGY SYSTECH

PLOT NO 99, SECTOR 7, PCNTDA, BHOSARI, PUNE - 411 026. ☎ +91 9175955198, +91 9657715917

info@energysystech.com I www.energysystech.com





MINDA INDUSTRIES LTD.

(Alloy Wheel 2W Division)

UNO MINDA
THINK. INSPIRE. FLOURISH

- FIFO at all stages of production cycle.
- Single piece flow
- Unidirectional flow
- Minimised Material Handling.
- Raw material to finished product in one shed
- Casting movements only through conveyers or AGVs.
- Flexible production set-up for variety of models
- Training room / DOJO room for operators Training
- Implementation of Industry 4.0

- Minda Industries Ltd has set up fully integrated manufacturing facility for Alloy wheel 2 wheeler.
- Facilities include state of art infrastructure for Foundry, Machining and Painting (Powder Coating & Liquid Painting) providing one stop solution
- Flexibility to manufacture a variety of sizes (range 10-19 Inches) & surface coats
- Location: Supa Industrial Area- 86 KM from Pune Airport
- Land: 20 acres
- Built-up: 24000 sq. mtr.
- Capacity: 4 Million Wheels p.a. , expandable up to 6 Mn

Robotic CNC Cells

Smart Conveyers

Auto Storage System

Product Portfolio

AGVs

CNC Robot

Pouring Robot

Replacement of Heater is now hassle-free and that to be in very little time....it's a big deal....

Kalyani Enterprises has launched New Electrical Aluminum Melting/Holding Furnace with a single shank heater, With this new technology, we can replace the damaged heater without removing the Crucible and without Shutting down the furnace for long time. Due To This Feature, You can Save Lots Of Time And Money.....

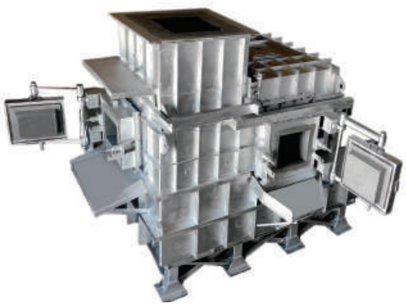
Note :- you can use this type of heater in your existing furnace with small modifications

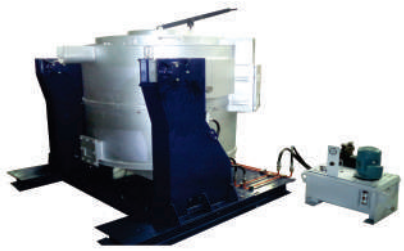
KEY FEATURES

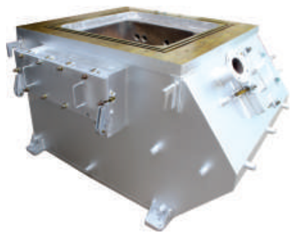
- No need to remove Crucible
- No need to cool down the furnace at room temperature
- Reduce production losses thus reduce energy consumption
- Increase crucible life
- Easy to remove & replace
- Heater replacement cost will be 40% due to new single leg Design
- Reduce Down time.
- Simple Design

Heater Replacement time

Activity	Brick Lined Aluminium Melting furnace	Ceramic Insulated Aluminium Melting furnace 2 Leg Heater	New Design Aluminium Melting furnace 1 Leg Heater
Cooling time	15 - 18 Hrs.	10-12 Hrs	No need to Cool down*
Top Plate Removing time	15 Min	15-30 Mins	15-30 Mins
Crucible Removal time	15-20 Min	15-20 Min	No need to remove crucible
Failed Element identification	15-20 Min	15-20 Min	15-20 Min
Element Replacement time for 1 Element	30-45 Min	30-45 Min	10-15 Min
Crucible Installation Time	15-20 Min	15-20 Min	No need to remove crucible
Top Plate Fixing time	15 Min	15-30 Mins	15-30 Mins
Heating Time for 1st melt	4-6 Hrs	3-4 Hrs	0.5 - 1 Hrs.
Total Down Time	17-20 Hrs.	15-19 Hrs.	1.5 - 2.6 Hrs.
	Time saving compare to Brick lined furnace		**15.5 - 17.4 Hrs.**
	Time saving compare to Fibre lined furnace		**13.5 - 16.4 Hrs.**







Contact Us

Kalyani Enterprises

Plot No. 30/10, F-2 Block, MIDC Pimpri,Pimpri Pune 411018 Maharashtra.

+91 9822060733 /+91 8308815022 marketing@kalyanifurnaces.com

www.kalyanifurnaces.com / www.kalyanifurnaces.in

Scan For Product Brochure

Scan Here

Watch Video

Report on Productivity Improvement
Theme: To Reduce Cycle Time at VMC Machine in Machine Shop

Team

Sudhir Narkhede

Prashant Naik

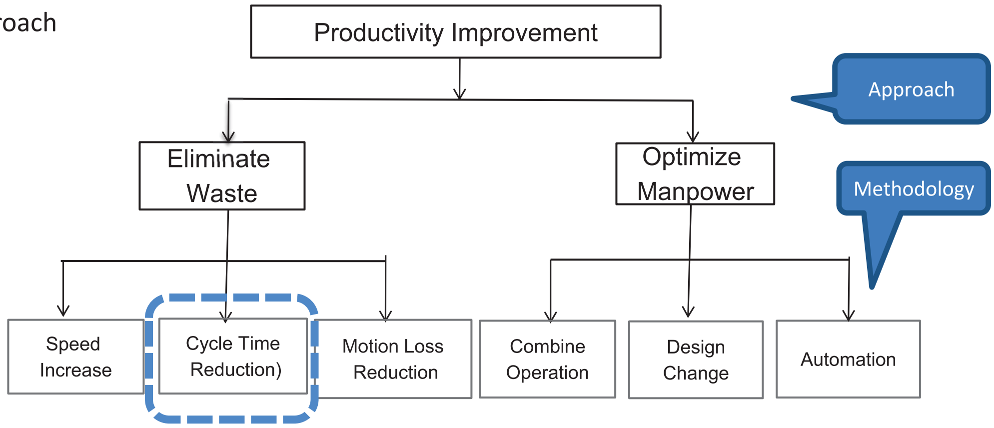
Babasaheb Satpute

Sanjiv Nikam

Pramod Gaikwad

Cycle Time Reduction Projects

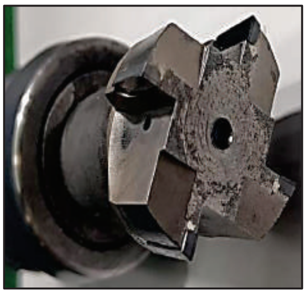
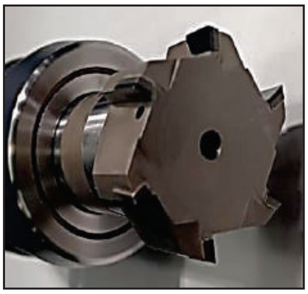
Approach

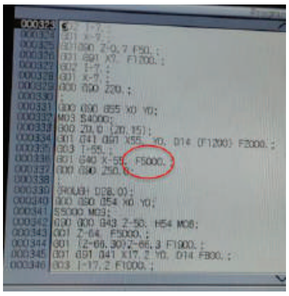
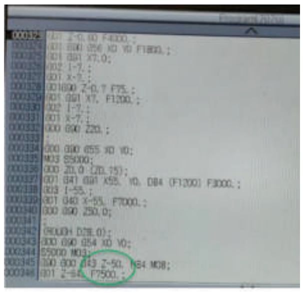


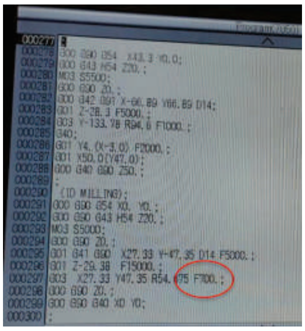
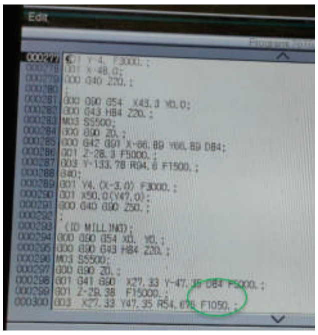
Total 19 Cycle Time Reduction Kaizen Identified in Machine Shop

Cycle Time Reduction Projects

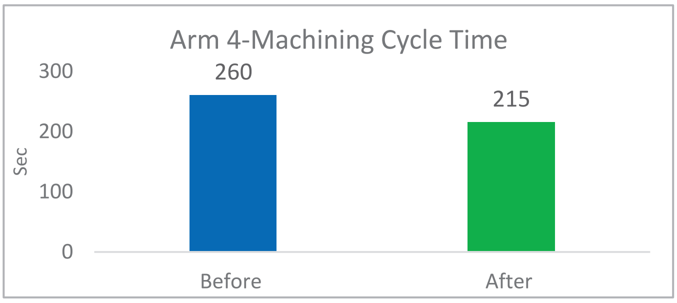
Sr No	Item Number	Alt Item Number	Part Name	Machine type	Completion Date	Before Cycle time in Second	After Cycle time In Second	Improvement-%
1	WHSGSA01AG. B15 RSMT	00753-2330-1102_REV:AG	Wireless Hsg	VMC	20-Mar-21	740	620	16
2	COVBK216 . B14 SMNS	A5E35758321_	216 Back cover	VMC	30-Mar-21	957	843	12
3	COVBXP208 . B14 SMNS	A5E33602854	208 Back cover	VMC	30-Mar-21	848	770	9
4	MTRCOV01BK. B32 RSMT	03031-0096-0001_ REV:BK	Cap-1	CNC	08-Apr-21	164	125	24
5	JNBOX01AH . B15 RSMT	00644-4193-0001 REV:AH	Junction Box	VMC	11-Apr-21	343	278	19
6	HSGND9100 . B14 MTSO	ND9100	METSO	VMC	15-Apr-21	755	590	22
7	HSGBS01 . B12 SMNS	A5E31454222A	SI Base Plate	VMC	26-Apr-21	946	720	24
8	AEBCOVTQ . B45 SMNS	A5E36028001_	Amber Blind cover	CNC	12-May-21	150	117	22
9	AEGCOVTQ . B45 SMNS	A5E36028014_	Amber Glass cover	CNC	28-May-21	178	135	24

Before	After
	
Four flute cutter	Six flute cutter

Before	After
	
Air cutting feed 5000 mm/min	Air cutting feed 7500 mm/min

Before	After
	
▪ Cutting feed 700 mm/min ▪ Cutting feed 1000 mm/min	▪ Cutting feed 1015 mm/min ▪ Cutting feed 1500 mm/min

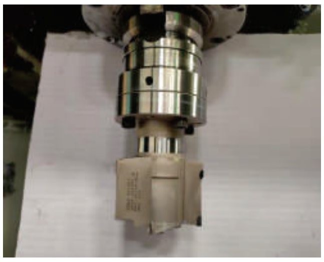
Results



Cost Saved - $6K/Annum

Saved 45 Sec/Part
17% cycle time reduced

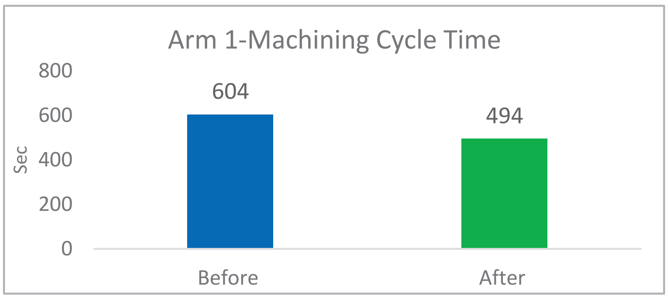
Kaizen 2 - Arm 1 Machining Cycle Time Reduction

Before	After
	
Boring & Chamfer tool required for Ø 63.9	PCD combination tool devolved for Ø 63.9 Boring finishing improved

Before	After
	
Boring & Chamfer tool required for Ø 35.014	PCD combination tool devolved for Ø 35.104 Boring finishing improved

Before	After
	
Boring & Chamfer tool required for Ø 26.1	PCD combination tool devolved for Ø 26.1 Boring finishing improved

Results

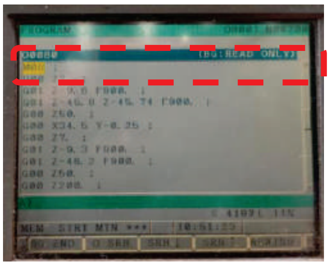


Cost Saved - $17K/Annum

Saved 110 Sec/Part
18% cycle time reduced

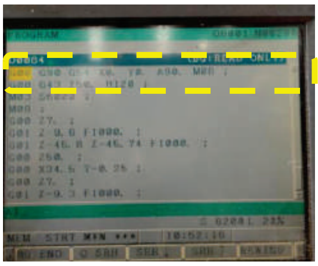
Kaizen 3 - Washer Hinge Machining Cycle Time Reduction

Before



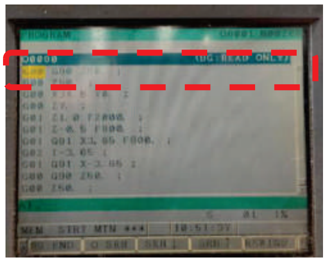
Cutting feed 900 mm/min

After



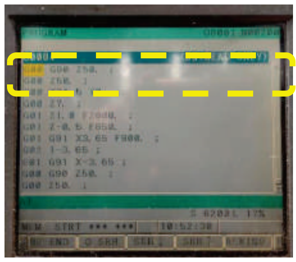
- Cutting feed 1000 mm/min
- Program modified

Before



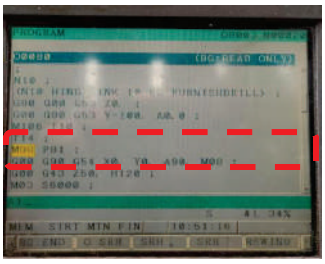
Air cutting feed 800 mm/min

After



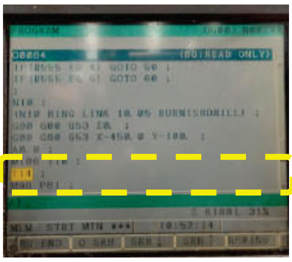
- Air cutting feed 900 mm/min
- Program modified

Before



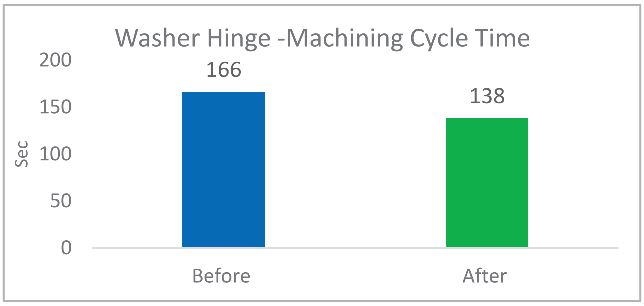
Axis movement time 18 Sec

After



- Eliminated axis movement
- Saved tool indexing time by 18 Sec

Results



Cost Saved - $2.76K/Annum

Saved 28 Sec/Part
19% cycle time reduced

Kaizen 4 - Cycle time reduction – VMC / CNC Machine

Part Name :- Pokethrough
Machine – VMC
Operations – Drilling (Hinge & Handle)
Cycle time – 47 Sec

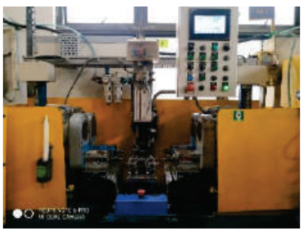
Major Improvements

- Fixture modified
- Tools modified (Special combination tool)
- OLD SPM modified with Servo Motor
- Program modified

Before

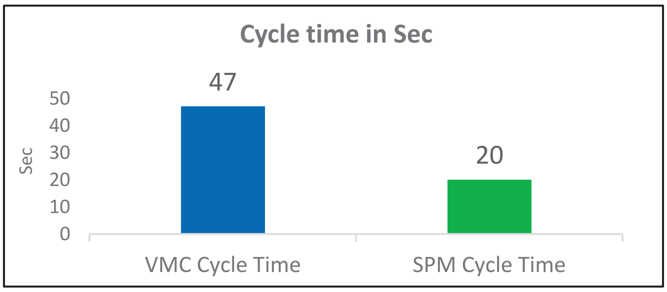
Machining operation on VMC

After



Machining operation converted on SPM

Results



Cost Saved - $6K/Annum

Saved 27 Sec/Part
57% cycle time reduced

Kaizen 5 - Cycle time reduction – VMC / CNC Machine

Before

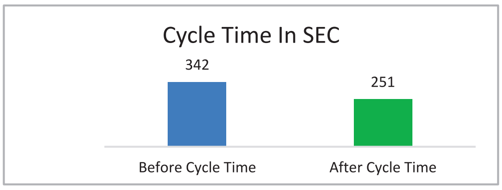
Three tools are using for DIA 6.5, DIA 7.7 and Chamfer tool

Two different tools used for DIA 9.1 and DIA 5.4

After

Combine tool used for DIA 6.5, DIA 7.7 and Chamfer tool

Combine tool used for DIA 9.1 and DIA 5.4



Cost Saved - $4.5K/Annum

Saved 91 Sec/Part
26% cycle time reduced

Kaizen 6 - Cutting Tools Modifications

Before

- Carbide triangular insert used
- Tool life-2000 Parts(180 Meter)
- Cycle time-32Sec.

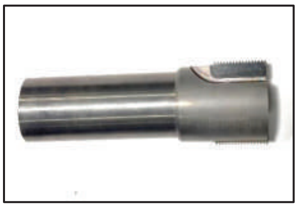
After

- PCD straight insert used
- Tool life-16000 Parts(1500 Meter)
- Cycle time-19Sec.

Before

- Carbide inserted thread mill used
- Tool life-1000 Parts(50 Meter)
- Cycle time -71Sec

After



- PCD thread mill used
- Tool life-1,00000 Parts(1500 Meter)
- Cycle time -47Sec

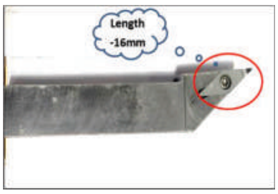
Before

- 4 tool used for drilling, reaming, back chamfer & chamfer.
- Cycle time-80Sec

After

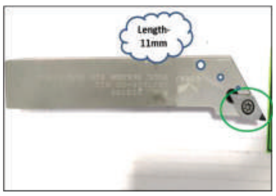
- Combination tool used for drilling, reaming, Back chamfer & chamfer.
- Cycle time-23Sec

Before



- VCMT160404 PCD Insert with Holder Used
- Tool life-2047 Parts(40 Meter)
- Cycle time-32Sec/Part

After



- DCMW110304 PCD Insert with Holder
- Tool life-11569 Parts(226 Meter)
- Cycle time-20Sec/Part

Results

Total Saved $179K/Annum

GREAT DIE CASTING TECHNOLOGY FORUM

Programme Calendar 2023-2024

April
19 Wed | 20 Thu | 21 Fri

Three days for beginners

APRIL 2023

May
18 Thu | 19 Fri

HPDC - Die Design, Defect Analysis

MAY 2023

June
22 Thu | 23 Fri

Methoding

JUNE 2023

July
20 Thu | 21 Fri

Core Technology

JULY 2023

August
17 Thu | 18 Fri

Metallurgy of Cast Alloy & Heat Treatment. Phase Diagrams, Case Studies, Foundries Characteristics

AUGUST 2023

September
14 Thu | 15 Fri

Melting, Melt Treatment, Melt Assement, Crucible

SEPTEMBER 2023

October

OCTOBER 2023

November


DIWALI FESTIVAL

NOVEMBER 2023

December
1 FRI | 2 SAT | 3 SUN

MEGA EVENT CHENNAI

DECEMBER 2023

January
11 Thu | 12 Fri

Defect Analysis & Remedial Measures NPD

JANUARY 2024

February
8 Thu | 9 Fri

Workshop for Pistons Industry

FEBRUARY 2024

March
22 Thu | 23 Fri

Workshop for Wheels Industry

MARCH 2024

* Programmes subject to change

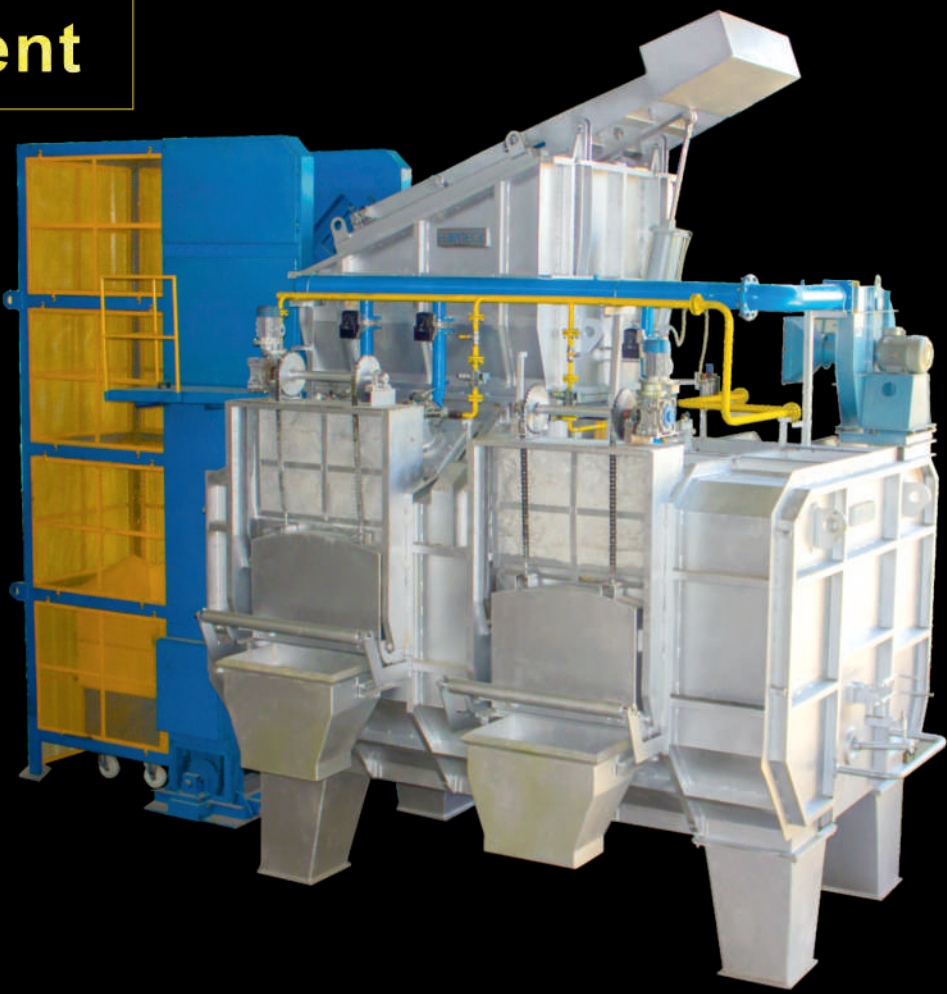
Reserve Your Dates

GREAT DIECASTING TECHNOLOGY FORUM
'Guruprasad', 37/4/A, 6th Lane, Prabhat Road, Pune 411 004 India
Office : +91 20 2567 0808 | Mobile : +91 9764711315,
gdctech@arkeycell.com, arkeyconference@arkeycell.com
www.gdctechindia.com

FURNTECK

EFFICIENT | ECONOMICAL | RELIABLE

Furnteck's most trusted
Tower Melting Furnace
is **now**
Extra Efficient



Energy consumption
<575 KWH/TON @ **53** LTRS/Ton of F.O.

with METAL YIELD of
>99.4%

HIGH **Quality**
METAL

LOWER GAS
INCLUSION

Complete Solution for Aluminium Industry under one roof

Direct Bale Out Type

Electrical Holding (Crucible)

Top Heated Holding

Ladle Preheater

Kattle Type
Transfer Laddle

Address: Gat No.244/1, Near Courtyard Marriot, Chakan-Talegaon Road, Khalumbre, Chakan, Pune - 410 501.
Mob: +91 9850 499 663 / +91 9075 020 450
Email: response@furnteck.com | **Website:** www.furnteck.com

When You Think Foundry... Think KELSONS...!

KELSONS®
TESTING EQUIPMENT

Centralized Software System with All Digital Equipment

MAKE IN INDIA

1994 - 2019 25 YEARS EXCELLENCE KELSONS GROUP

KELSONS TESTING EQUIPMENT

G-35, M.I.D.C. Shiroli, Kolhapur - 416 122 Maharashtra. (INDIA)
PH. : +91 230 2469067, 2469079 **Cell :** +91 9422582869
E-mail : sales@kelsonslab.com **www.**kelsonssandtesting.com
www.kelsonsfoundryequipments.com

EXPORTS : Malaysia, ,Syria, Dubai, Iran, Turkey, Saudi Arabia, Thailand, Egypt, Uganda, Oman, Germany, Baharin, South Korea, Bangladesh, Nigeria, South Africa, Croatia, Finland, Vietnam

PRODUCTS RANGE - For Structural Properties Testing, For Mould & Core Testing, For Green Moulding Sand Testing, For Oil Core Sand Testing, For Furan / No-bake Testing, For Hot Box Sand Testing, For Shell Sand Testing, Calibration Kits.

We Also Manufacture Foundry Machinery, Metal Testing Equipment.

Design FLASH-99 22 22 7007

Venue
Chennai Trade Centre
Chennai, India

GDC TECH Great Die Casting mega event 2023 ALUMINIUM DIECASTING EXHIBITION & CONFERENCE

1-2-3 December 2023
(Friday to Sunday)

PATRON

FOSECO

SUPPORTERS

AAKAR FOUNDRY PVT. LTD.	ALPHACRAFT	Aurangabad Electricals Ltd. A CIE AUTOMOTIVE GROUP COMPANY	CARL ZEISS INDIA PVT LTD.
Inspiron Innovation First	maxop eminence with excellence...	Morgan Advanced Materials	BAGLA
CERAFLUX ISO 9001 Certified Company	DIMO CASTINGS PVT. LTD	ESKO	Forace Group
POOJA CASTING PVT.LTD	Pyrotek	Sundaram-Clayton Limited	UNO MINDA

NEWCAST

ORGANISED BY EEPCINDIA ENGINEERING THE FUTURE

SUPPORTED BY ALUMINIUM GDC TECH GREAT DIE CASTING

Become an exhibitor at NEWCAST 2023

INDIAN ALUMINIUM DIECASTING PAVILION AT NEWCAST

NEWCAST is the most important global platform for custom-made cast products, where you will find everything which moves innovative casting technologies.

6th International Trade Fair for Castings

2023

12 - 16 June 2023 Dusseldorf, Germany

NEWCAST

- Ferrous Metal Castings
- Iron, Steel and Malleable Foundries
- Non-Ferrous Metal Castings
- Aluminum, Zinc, Copper, Magnesium, Nickel and other Non-Ferrous Metal Foundries
- Services, Forging, Sinters
- Trade and Logistics.

Venue

Düsseldorf Fairgrounds Messeplatz
40474 Düsseldorf, Germany

Date

12 - 16 June 2023

FOR DETAIL BROCHURE & BOOKING FORM CLICK
https://upload.eepcindia.com/eepc-download/eepc_files_31102022_110556.pdf

Participation Charges

- **Booth size: 9 sqm**
  One side open (built-up booth):
  INR 35,000 per sqm.
- 10% extra for two sides open booth (subject to availability)
- GDCTECH administration Charges:
  INR 15000/- (Purposed)

Note:
1.The above rate is subject to receiving of Government sanction for the event for organizing an India Pavilion.
2.EEPC India reserves the right to reject an application for participation without assigning any reason.
3.In case of not receiving a minimum number of participants, EEPC India may decide not to participate in the show.
4.No subletting or sharing of space/ booth is permitted.

Participate at NEWCAST 2023 through EEPC India and GET BENEFITS!

EXCITING TRAVEL PACKAGES

TO GIFA-NEWCAST-THERM PROCESS AT GERMANY

- Travel Package for Exhibitors
- Travel Package for Visitors

TOUR PRICE INCLUDES

- Return economy class airfare based on option as proposed
- Accommodation on twin sharing basis.
- Daily Continental Hot Breakfast
- Airport-Hotel-Airport Transfers by Luxury Coach
- Daily Packed Lunches during GIFA
- Daily Indian Dinners at an Indian Restaurant (1900Hrs)
- Visa fee
- Overseas Mediclaim Insurance
- Services of an experienced TWORRLD Tour Director.
- TWORRLD Travel Kit.
- 24/7 TWORRLD Professional Support.
- Tips / Customer Gratitude's: EURO30

FOR PACKAGE COST & DETAILS PLEASE CONTACT

Organised By

ALUMINIUM GDC TECH GREAT DIE CASTING

GREAT DIECASTING TECHNOLOGY FORUM
Email- gdctech@arkeycell.com
mail@arkeycell.com
Mob- 9422016770/9307059071

Official Travel Partners

T WORRLD

TWORRLD
Email-operations@tworrld.com
Mob- 9623362778/9730311123

When You Think Foundry... Think KELSONS...!

Metal Testing Equipment
Mechanical, Digital, Computerized

KELSONS®
METALLURGICAL EQUIPMENT

MAKE IN INDIA

Brinell Hardness Tester (Digital)
Motorised Loading

Universal Testing
Machine (Electronic)
Digital with Computer Interface

EXPORTS :
Malaysia, ,Syria, Dubai, Iran, Saudi Arabia, Thailand, Egypt, Uganda, Germany, Baharin, Turkey, South Korea, Bangladesh, Nigeria, Oman, South Africa, Croatia, Finland, Vietnam

KELSONS METALLURGICAL EQUIPMENT

G-35, M.I.D.C. Shiroli, Kolhapur - 416 122 Maharashtra. (INDIA)
PH. : +91 230 2469067, 2469079 **Cell :** +91 9422582869
E-mail : sales@kelsonslab.com www.kelsonssandtesting.com / www.kelsonsfoundryequipments.com

We Also Manufacture Foundry Machinery, Metal Testing Equipment.

Design FLASH-99 22 22 7007

International Conference & Exhibition

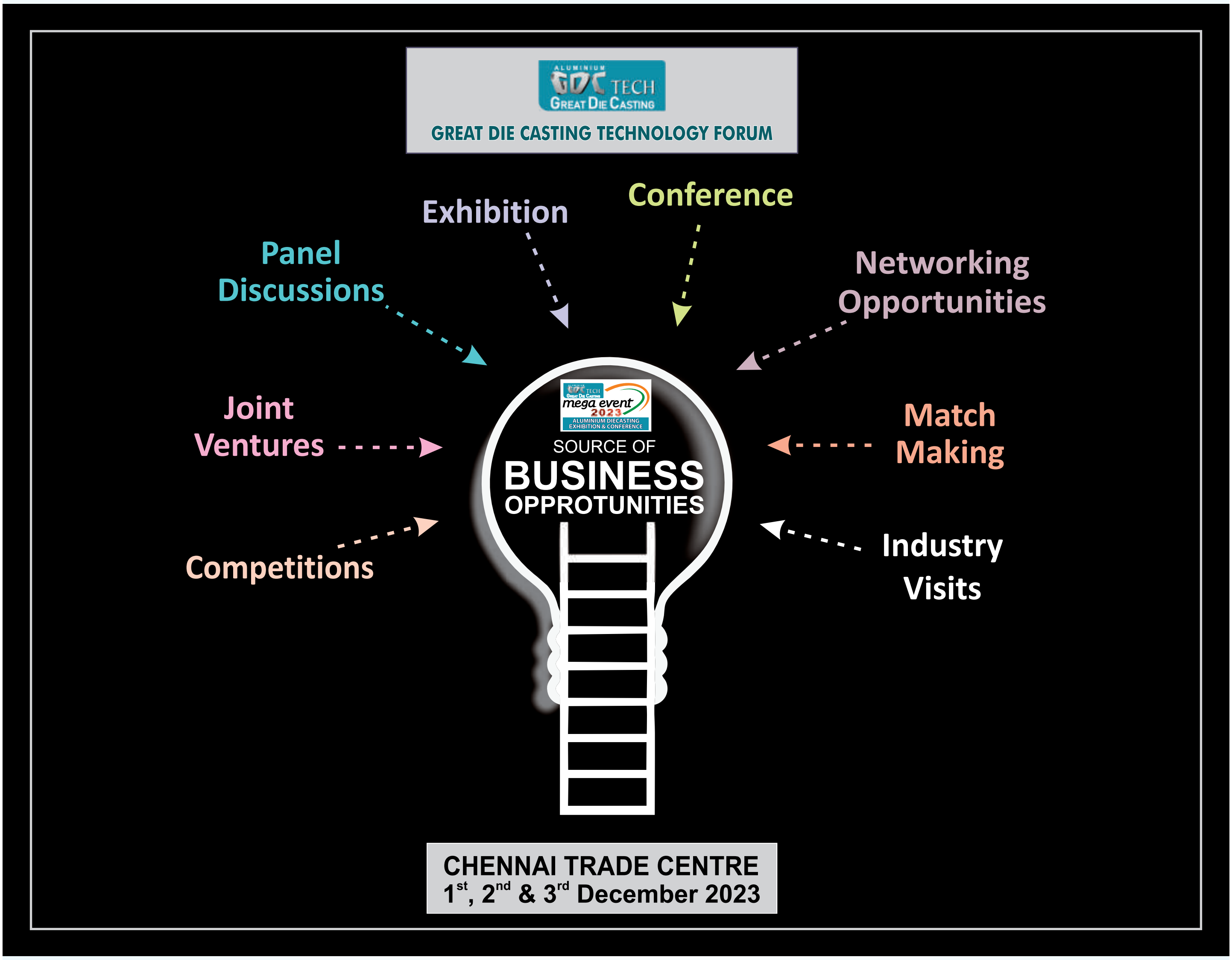
1-2-3 December 2023

at Chennai Trade Centre, Chennai, India

CONCURRENT EVENTS

GDC TECH mega event 2023 ALUMINIUM DIECASTING EXHIBITION & CONFERENCE — GDC TECH GREAT DIECASTING TECHNOLOGY FORUM **for Diecasting Industry**

FORGING TECHNOLOGY FORUM mega event 2023 — FORGING TECHNOLOGY FORUM **for Forging Industry**

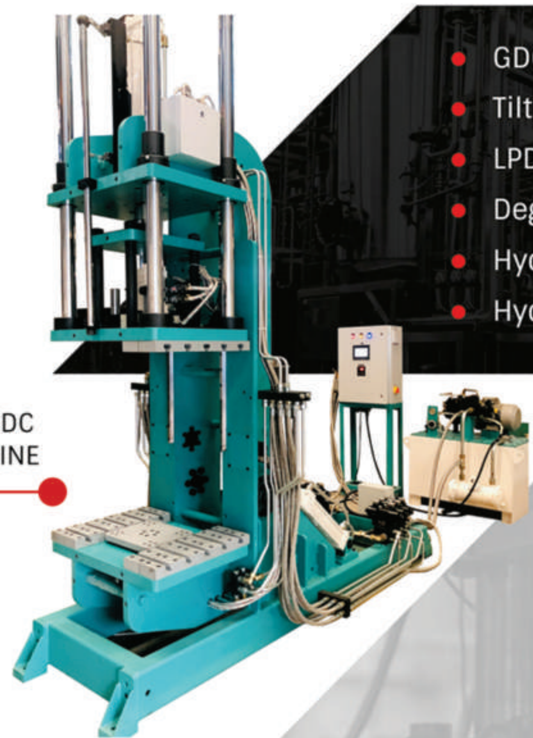


For Details please Contact :
GREAT DIECASTING TECHNOLOGY FORUM
Email: gdctech@arkeycell.com
Mobile: +91-9764711315
www.gdctechforum.com

Prominent Manufacturer in
Aluminum Foundry Machines
SINCE 2008

J B Engineering and Automation

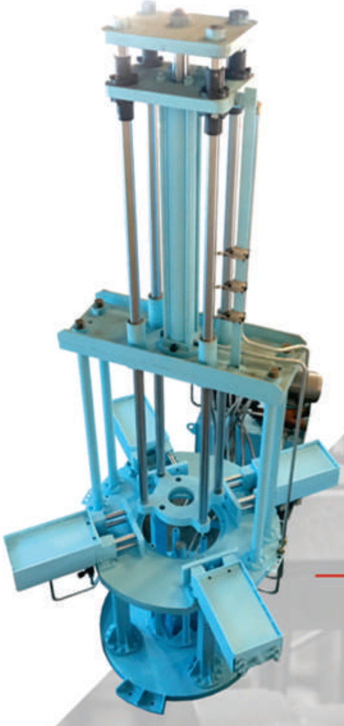
An ISO 9001:2015 Certified Company



- GDC Machines
- Tilting GDC Machines
- LPDC Machines
- Degassing Units
- Hydraulic Cylinders
- Hydraulic Power Packs

TILT GDC MACHINE

TILT GDC SHOCK ABSORBER MACHINE



2 WHEELER ALLOY WHEEL VERTICAL GDC MACHINE

Authorised Distributor of

O.MLER
Innovative Solutions

Address : Gat No. 228, Barane Wasti, Behind D-Mart Mall,
Moshi - Dehu Road, Moshi, Pune - 412105. MH. India.
Mobile : +91 93251 96727 / 98236 71338
E-mail : pramod.j@jbengineering.co.in, rahul.b@jbengineering.co.in

www.jbengineering.co.in | www.jbengg.in