ALUMINIUM GDC TECH GREAT DIE CASTING

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JOURNAL FOR ALUMINIUM CASTING TECHNOLOGY

Volume 59 - August 2023

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VESUVIUS

FOSECO

CLEANING AND DROSSING GRANULATE FOR STRUCTURAL HIGH-PRESSURE DIE CAST ALUMINUM COMPONENTS

Authors: Kerstin Berndt, Philip Schütten, Ronny Simon

This paper proves in detail and with the participation of industry (Magna Cosma) and science that under today‘s technological conditions the use of granulates in die casting is not only harmless but also economically and ecologically important.

MAGNA COSMA INTERNATIONAL

INTRODUCTION

The use of chemical products has been the accepted standard for decades in sand, gravity die and low-pressure foundries casting aluminum alloys. Granulates are used for melt cleaning, grain refining, modification or drossing.

In the past, the addition of salt-based preparations such as powders or tablets was usually done manually. The disadvantages of this approach are uncontrolled addition rates and insufficient reaction in the aluminum melt, increasing the risk of salt inclusions in the casting. In many cases this would result in quality problems during welding (pore formation) and heat treatment (blister formation).

In high-pressure die casting (HPDC), the critical question therefore is to what extent chemical melt treatment is possible. In the case of weldable thin-walled Aluminum structural castings produced by high-pressure die casting, many foundries are reluctant to use chemical products such as granulates.

Automotive manufacturers as important end customers for such structural castings are also skeptical about the use of chemical products, despite the high economic benefits. Risks in series production and the lack of investigations and data, in many cases outweigh the known metallurgical and economic advantages of chemical treatment. However, with the introduction of the MTS 1500 process and continuous recipe optimization of the cleaning and drossing granulates, the technology has advanced significantly.

Foseco took this as an opportunity to re-evaluate the application of granulates using the MTS 1500 process for structural castings. This study on the long-term testing of granulates in high-pressure die casting was planned and carried out in collaboration with the company Magna BDW technologies in Soest (Germany) and an expert in metal forming, materials science and welding processes from a University in Germany.

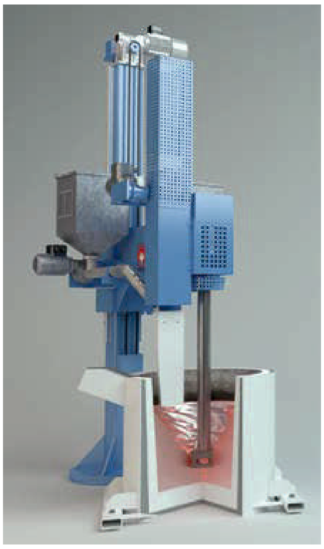

Figure 1: MTS Process

Metallurgical advantages:

- Consistent mechanical and physical properties
- Homogeneous microstructure and composition
- Low oxide content
- Controlled gas porosity

Economic advantages:

- Reduced treatment costs due to lower inert gas and granulate consumption
- Low metal dross formation
- Increased efficiency due to faster metal turnover
- Reproducible melt quality
- Increased reliability with reduced maintenance requirements

Improved health and work safety:

- Reduce particle and gas emissions by adding less granulate

- Vortex draws the granulate into the melt immediately after addition and mixes it intensively with the melt
- Granulate is reacted during treatment, there is no unwanted
- interaction on the melt surface
- Operator of the unit is not directly involved in the treatment process and is located outside a potential risk area

Improved environmental protection:

- Reduced use of consumables
- Reduced amount of dross
- Reduced emissions of Co2
- Reduced temperature loss due to shorter treatment time

(energy savings)

A complete overview of the MTS 1500 process is given inFoundry Practice article FP 247 (2007) „MTS 1500 - Automated Melt Treatment“

TASK DEFINITION AND EXPERIMENTAL PROCEDURE

The objective of this long-term test was to confirm that no residues remain in the casting when the granulate is added by the MTS treatment and thus the process has no negative influence on the casting properties.

For the experiment, an FDU MTS 1500 rental unit from Foseco was provided to Magna Cosma together with the appropriate Foseco graphite consumables.

The degassing parameters were taken from the existing production unit and times and rotor speed were evaluated for vortex formation. The amount of granulate added depends upon operational conditions such as the amount of scrap used, the alloy, the treatment temperature, and the ladle geometry.

The optimum addition quantity was determined in a preliminary test. For this purpose, different addition rates (0.02%, 0.04% and 0.06% of the metal weight) of the COVERAL ECO 2531 granulate were added in each of 3 trials using the MTS method. After treatment, density index, Vmet (Vesuvius metal cleanliness analysis) and dross samples were taken.

Based on these results, an addition rate of 0.06% Coveral ECO 2531 was determined as optimum for the long-term test, as this provided both the best metal quality and the most economical result.

PARAMETERS

Shaft FDU BKF 75/900.70
Rotor MTS FDR 190.70
Baffle plate I180 PL 04.500.2
Alloy AlSi10MgMnFe
Transfer ladle with 650 kg (1,430 lbs) of melt
Temperature 730 °C (1,350 °F)

ANALYTICAL METHODS AND THEIR SIGNIFICANCE FOR THE EXPERIMENT

Density index

The density index (DI) is the quotient of the density of a sample solidified in vacuum compared to a sample solidified at athmospheric pressure and is an indirect measure of the hydrogen content in the melt. However, since gas is also preferentially precipitated on nuclei such as oxides in the vacuum density sample during solidification, a low-density index also means a very good and low-oxide melt quality. [1]

$DI=(Rho_{atm}-Rho_{80mbar})/Rho_{atm}x100\%$

Density index is by far the most widely used process parameter, which in practice is used as a quality control tool in production before the melt is poured.

The measuring method is low-cost and easy to handle, even if it is not very selective. The density index describes the total hydrogen and oxides in the melt. Even if the density index itself does not initially allow any statement about the amount of hydrogen or oxides present, the density index is a meaningful parameter for this long-term test. Constantly low DI values indicate a clean melt, and the high number of measurements provides a sufficiently high statistical confidence.

Vmet Analyse

The Vmet analysis is a specially developed method used for the qualitative and quantitative characterization of the melt cleanliness. Here, the sample solidifies in a special mould and a defined section is used for further examination.

An 1 cm^2 piece of the sample is prepared metallographically and scanned fully automatically using a scanning electron microscope. Defects are chemically analyzed by electron beam and their size is

measured. The results are divided into 3 categories (pores, alumina, and oxides of alloying elements), and grouped into 4 size intervals (0.5-15 µm, 15-30 µm, 30-75 µm, >75 µm).
This method is more precise due to the automated measurement process and will detect any residues of salt in addition to assessing the melt cleanliness in terms of oxides. The effort and costs of VMet analysis limit the number of possible samples.

Aluminum content in the dross

In this method, the aluminum content in the skimmed dross is measured after treatment with granulate. For this purpose, 750 g of the dross sample is mixed with 750 g of flux, heated to 800 °C for 8 hours and stirred several times.
During this time, 2 phases form in the crucible. The aluminum phase collects at the bottom, and the oxide-containing salt phase settles above it. The crucible is then allowed to cool, and the phases are separated mechanically. [Fig. 2]
Special regulations for homogenization and sampling of the dross ensure that a representative quantity is analyzed. This method is used, on the one hand, to calculate total process costs and, on the other hand, to check the correct amount of granulate is being added.

Figure 2: Metal phase and oxide-containing salt phase after dross analysis

Scanning electron microscope (SEM) examination

The scanning electron microscope makes it possible to view the microstructure of a sample at very high magnification and to qualitatively determine the chemical composition of certain areas.
The expert used SEM to examine different density and fracture samples with and without granulate treatment for any anomalies. Two of the samples were additionally annealed at 540 °C for 1 hour, to visualize possible salt reactions on the fracture surface.

X-ray fluorescence analysis

In energy-dispersive X-ray fluorescence analysis (XRF), atoms are excited to emit
their characteristic X-ray fluorescence radiation using an X-ray tube. The radiation emitted by the sample is separated in the spectrometer, so that the intensities of individual spectral lines or spectral regions (wavelength-dispersive) can be measured. [Fig 3]
This method is used to detect salt residues in the dosing furnace lining.

OBSERVATIONS FROM THE TRIALS

During the entire 8-week trial period, density index samples were regularly taken from each transport ladle - both using the standard process and the MTS process. Once a week, additional Vmet samples were collected from the transport ladle and the holding furnace and compared with the standard process.
Residual aluminum analysis in the dross was performed three times throughout the test run. Analysis of the fracture samples was performed weekly, and examination of the furnace material was performed once. During the trial period, cleanliness improved throughout the process. Employees repeatedly and independently reported that both the ladles and the holding furnaces were less dirty, and the cleaning process was significantly easier. As a result, the initial skepticism of the employees towards the new MTS technology with granulate was significantly reduced.
For a safe process, the ladle must always be placed centered under the degassing unit. Under trial or in-production conditions, this was not always the case, the granulate sometimes reacted at the melt surface, and there was occasionally slight smoke development during treatment. A workplace analysis was carried out by an authorized company to determine the hazard potential, in order to provide greater safety for all involved.
During this measurement, inhalable dusts as well as fluoride emissions were determined. These values were used to determine whether the use of granulates could be hazardous to employees and the environment. Results confirmed, Fluoride emissions were below the detection limit. The inhalable dust levels were in the lower quarter of the maximum workplace concentration. This confirms the MTS process using a granulate, does not present a risk to employees and or environment. An additional finding from this longterm test is that the oxide content has a

significant influence on the density index. As mentioned at the beginning of this article, the relative influence of hydrogen content and oxide content on the density index value cannot be determined.

The consumables geometry - graphite rotor MTS FDR 190.70 – was the same for both processes – standard process and MTS process during the test. Thus, no change is to be expected with regard to the effectiveness of hydrogen removal. Based on more than 250 measured values, the process without granulate addition shows a density index below 4 %, the process with granulate addition always below 2 % density index. Through this test setup, we can conclude that the oxide content reduced by the granulate addition in this process contributes about 2
% in the density index.

In general, it can be concluded that the influence of the oxides in the density index is significantly higher than previously assumed.

Figure 3: Dosing furnace lining sample

RESULTS

Melt treatment

A significantly lower density index value after treatment with COVERAL ECO 2531 by means of MTS 1500 proves a better oxide removal. The Vmet analysis confirms this observation and shows an improved melt cleanliness by a factor of 6.

	Density index	Vmet Analysis	Metal content in dross
Without COVERAL ECO 2531	< 4 %	460 defects	95 %
With COVERAL ECO 2531	< 2 %	75 defects	50 %

Table 1: Results from melt samples

In addition to quality, the economic aspect must also be considered in any process optimization. The basis for this is an aluminum content measurement of the dross. This saved metal remains in the ladle and can be cast directly to produce additional castings. In this application, about 3 kg of dross per ladle are skimmed off and discharged. The use of COVERAL ECO 2531 saves 45 % aluminum in the dross, which corresponds to 1.35 kg.

The overview shows an example of a process cost evaluation (as of February 2023). Other favorable factors such as scrap reduction, reduced tool wear in machining and shorter cycles in furnace and ladle cleaning, are not considered in the cost assessment and provide additional benefits.

EVC-Calculation for Customers 06.02.2023

General conditions / reference values general	
Amount of transport ladle[kg]	650
Volume treated metal / month [t]	1000
Alloy costs (metal + energy) [€ / kg]	2,30
Refund on dross [€/kg]	0,80

FOSECO

General conditions / Reference values comparison	Actual process	FOSECO Process
Granulate	Only degassing	Coveral ECO 2531
Amount added granulate [%]	0,00	0,06
Residual aluminium content in dross [%]	95	50
Dross quantity [kg]	3,00	3,00

Legal costs	Actual process		FOSECO Process	
	Amount [kg]	Value [€]	Amount [kg]	Value [€]
Metal loss (alloy costs metal + energy)	2,850	6,56	1,500	3,45
Costs for granulate	0,000	0,00	0,390	0,59
Costs for comsumables		0,80		1,00
Refund for Al in dross	3,000	-2,40	3,000	-2,40
Cost per treatment		4,96		2,64

Savings Foseco-Process per ladle	2,32 €
Savings Foseco-Process per kg	0,0036 €
Savings Foseco-Process per month	3.569,23 €
Savings Foseco-Process per year	**42.830,77 €**

CO_2 Saving Foseco-Process per ladle in kg CO2	0,51
CO_2 Saving Foseco-Process per kg in kg CO_2	0,38
CO_2 Saving Foseco-Process per month in kg CO_2	783,70
CO_2 Saving Foseco-Process per year in kg CO_2	**9404,37**

Table 2: Process cost comparison

Examination for salt residues

A fracture area examination by scanning electron microscope shows no traces of any salt residues, neither in the original nor in the heat-treated condition. [Fig. 4]

Figure 4: Aluminum sample for SEM examination – after heat treatment

EDX (Energy Dispersive X-Ray) analysis of the furnace linings also shows no evidence of salt residues. [Fig. 5]

Analysenparameter	Einheit	Ergebnis
Elemente / Kationen		
Aluminium (Al)	%	12.6
Calcium (Ca)	%	4.4
Eisen (Fe)	%	0.07
Kalium (K)	%	0.05
Magnesium (Mg)	%	0.05
Natrium (Na)	%	0.26
Phosphor (P)	%	0.11
Silizium (Si)	%	32.2

Figure 5: EDX-results from furnace lining examination

Our materials expert concludes after his research:

> "Similarly, the results of the present investigation indicate no negative influence on the casting quality in terms of mechanical properties, weldability, heat treatment (blister formation, corrosion characteristics)."[2]

SUMMARY

The approach described in this article was intended to investigate whether the concern about negative consequences in the chemical treatment of melts for weldable high-pressure die casting is well-founded.

With the aid of a high-quality and extensive test setup, it was finally proven that the use of granulates by means of the MTS process, can achieve better melt quality and make the process more economical and sustainable. In addition, it was clearly established that the correct use of Foseco's melt treatment agent COVERAL ECO 2531 has no negative impact on casting quality, weldability or corrosion resistance. These practical trials were accompanied and validated with the aid of the most up to date laboratories and test methods, with the involvement of independent partners from research and development.

This project conclusively demonstrates the advantages of using stateof-the-art melt treatment equipment combined with the use of technologically advanced granulates. Improved casting quality, financial savings including the return of investment of a new MTS unit of one year, as well as a significant CO2 saving of 9 tons per year are reason enough to rethink and challenge existing processes.

REFERENCES

1 Gießerei Lexikon

2 Final trial – Application of drossing and cleaning fluxes for structural components in HPDC – long term trials with COVERAL ECO 2531 (Magna, Foseco, Prof. Winkler)

ABOUT THE AUTHORS

Kerstin has worked at Vesuvius GmbH since 2006 in melt treatment for non-ferrous metals. She developed Nucleant 1582, managed Germalux, and now oversees the Non Ferrous Metal Treatment product group as European Product Manager. She lives with her family near Borken, enjoys dancing, and is involved in charity work.

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KERSTIN BERNDT
European Product Manager
Non-Ferrous Melt Treatment

Philip joined Vesuvius in 2015 in the non-ferrous sales team and today works as Technical Manager NF for Northern Europe. In this position he collaborates with our customers, partners and management to find optimal solutions for the foundry industry. In his free time, Philip enjoys traveling with his wife and two children.

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Technical Manager
Northern

Ronny, with Foseco since 1998, managed multiple product areas in Europe's non-ferrous foundry sector and significantly influenced product strategy. Notably involved in MTS technology and chemical product development, he transferred to Cleveland, OH in 2021 as Technical Manager for NAFTA, exploring the new environment with his family.

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RONNY SIMON
Technical Manager
Non-Ferrous

DIE COST OPTIMIZATION

Bharataj Patil, DGM QA & Die casting Engineering
Godrej Tooling Division, Mumbai

What drives Tooling cost?
Die design
Die maintenance
Die life required

Some manufacturers may be tempted to cut costs by purchasing a cheaper, lower quality tool. While these tools may have lower investment at initial stage, but they need higher investment down the line in the form of costly un-necessary maintenance, tool replacement and higher rejections.

By investing in higher quality tooling, manufacturers get the benefits of greater ROI with Prolonged tool life, Lower rejection rate throughout the life of the project and Improved part performance.

When designing your component, the following points should be considered to ensure good die life that produces high-quality parts:

Collaborate with team of experienced Die Designers to make the unique changes to your specific part early on it at the design phase to avoid costly re-designs.

Allow for Lenient tolerance zones & Lower porosity requirement on non-critical design elements

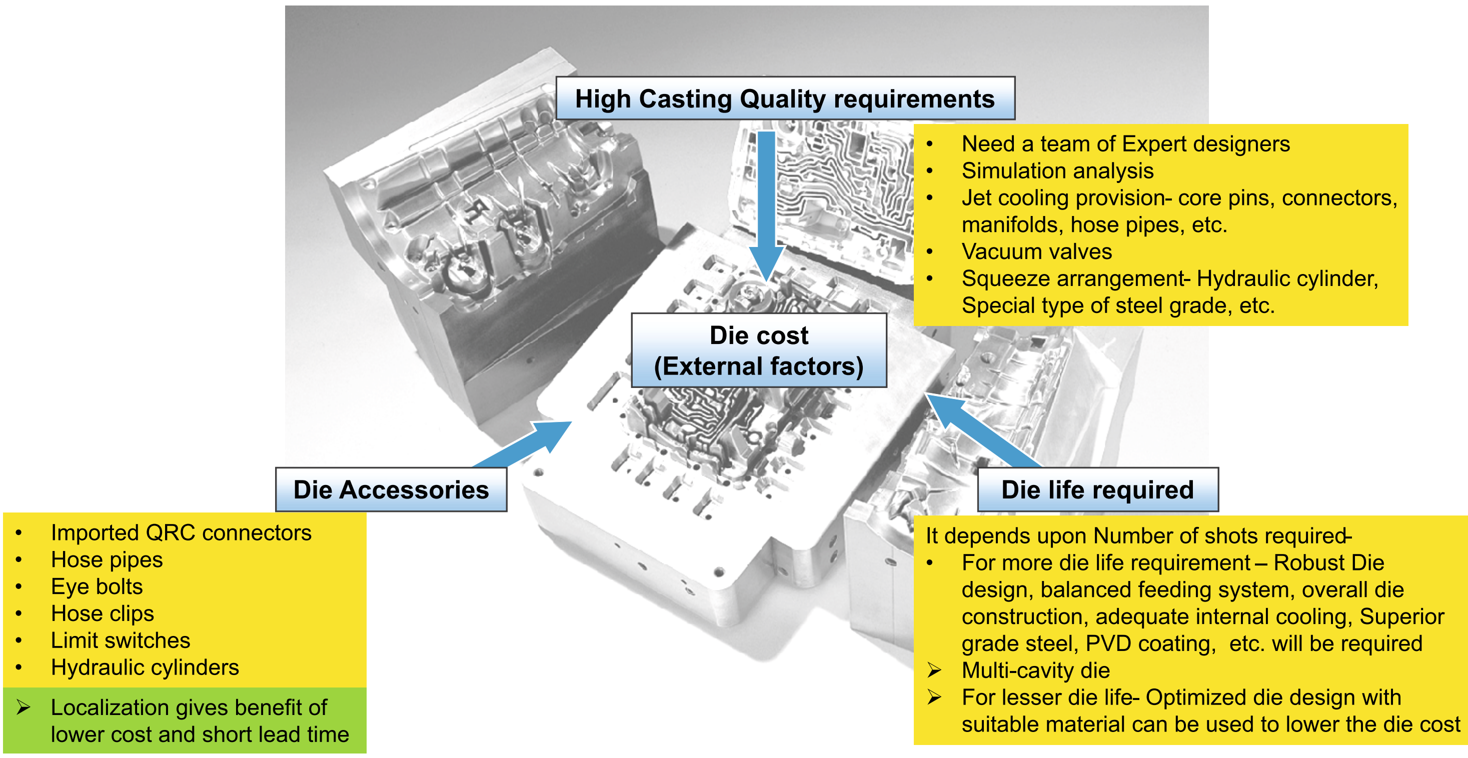
Increasing draft angles of non-critical design elements allows for easier part extraction, which extends the service life of the tool

External factors:
Casting quality requirement
Die life required
Die accessories requirement as per customer standards

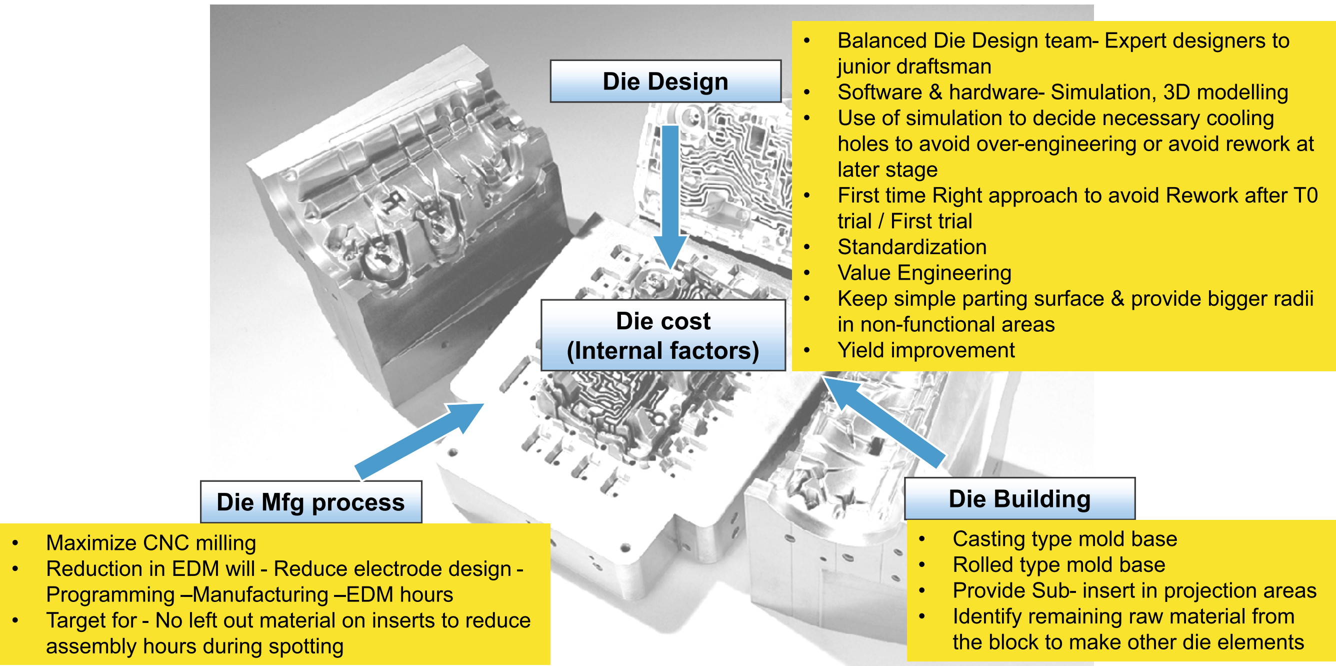
Internal factors:
Die design
Die manufacturing process
Die Building
+ Other Fix cost elements

During Die Optimization we must think on overall Die performance throughout the desired die life.

Factors Affecting The Die Cost - **External**



Factors Affecting The Die Cost- **Internal**



Reduce:
- Die Design time
- Die machining time
- Die assembly time
- ➢ Per piece cost of the casting

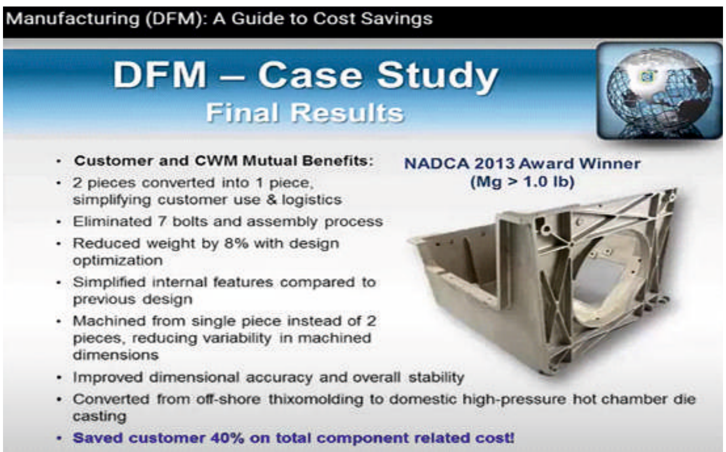
Eliminate:
- Unwanted parts

Optimized Die design

Create:
- Value engineering by DFM
- Standardization

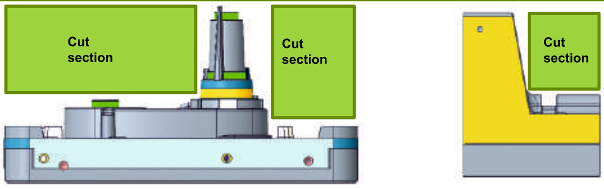
Raise:
- Yield improvement
- Die life enhancement

DFM expediate the tool design process by delivering a successful tool that will last the life of the project, but also makes for a more consistent, high-performing component than lower-quality tools

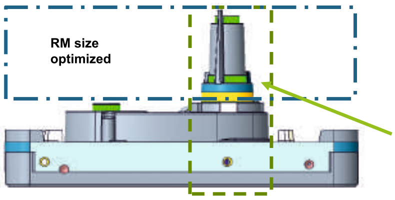


- It is always a good idea to include a die casting engineer during the part design phase. It can translate into major cost savings in both design and production over the die life.

Some examples of cost saving

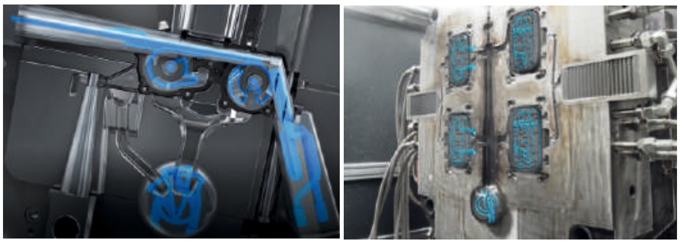


- **Make Cut sections of RM** based on product geometry which can be used to make **remaining material for other details**
- This will also **save the machining cost for scooping** this material



- **Removable insert for projection area** to reduce RM size (if parting line is allowed)

Conformal cooling for cost saving



Conformal cooling inserts made by 3D printing

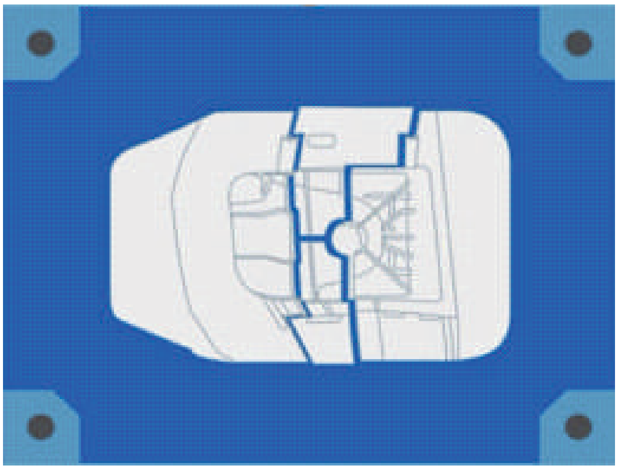
Puzzle Die concept for better die life

Designing the tool with Removable inserts, allows you to replace these inserts during production. If a tool is eroding quickly, instead of replacing the entire tool, which adds cost and slow production time, only part of the tool needs to be changed.

We can predict which area of the tool will wear faster and make that a removable insert.

It will give better part-to-part consistency at a lower cost & better die life.

- ## Next step is Puzzle die concept:



Reference : concept by CO STAMP Italy

Understanding how and where dies are likely to fail enables engineers to design them to fail in controlled ways.

This is achieved by designing dies to include parting lines that separate the die segments, like parts of a puzzle.

The parting lines are placed exactly where the die would eventually break anyway due to stress. It is based on a simple principle, "'what is already broken can't break any further'.

Die life was extended by 50-150 %. The key principle was preventing the fatigue accumulation that leads to the dies breaking.

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(Alloy Wheel 2W Division)

- 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.
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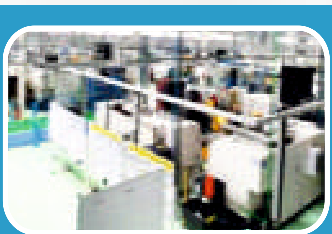
- Land: 20 acres
- Built-up: 24000 sq. mtr.
- Capacity: 4 Million Wheels p.a. , expandable up to 6 Mn



Robotic CNC Cells

Smart Conveyers

Auto Storage System

Product Portfolio

AGVs

CNC Robot

Pouring Robot

ALUMINIUM FURNACES

ENERGY SYSTECH

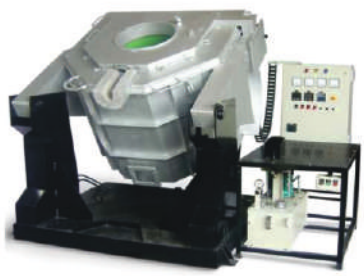
Sklenar-type Melting Furnace

"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

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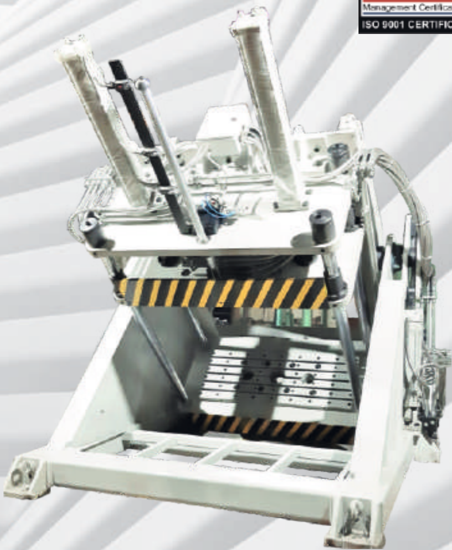

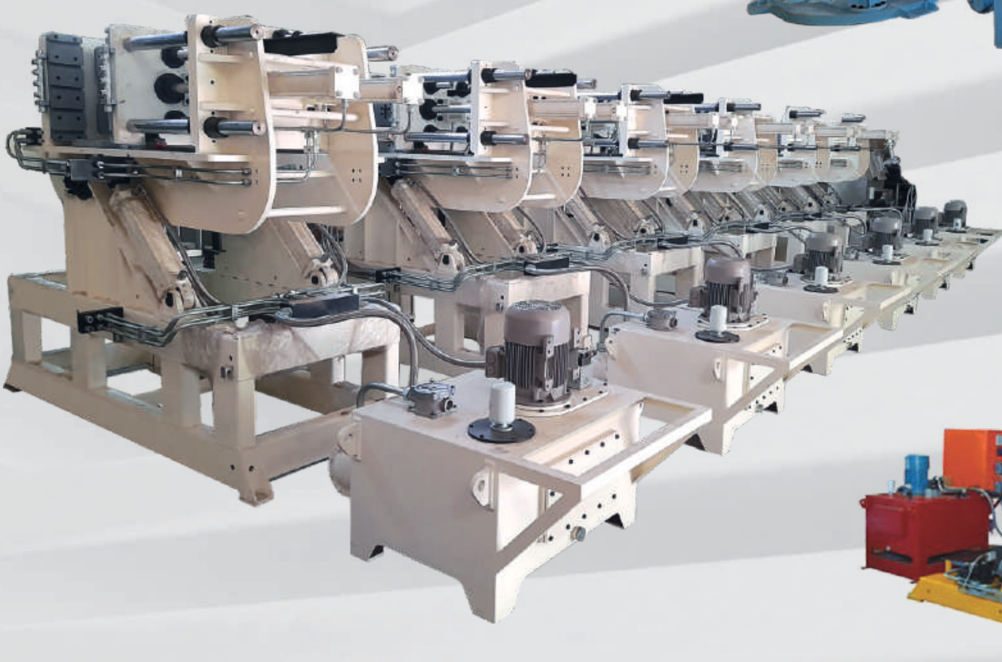

Five Steps for Die Life

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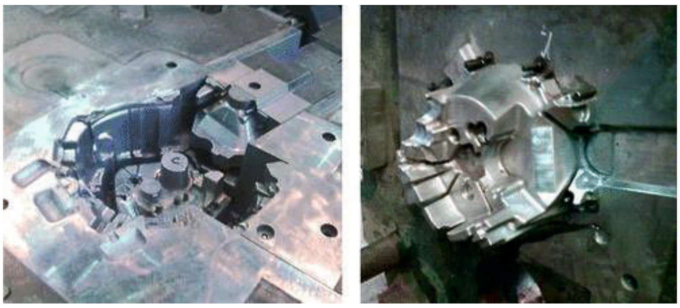
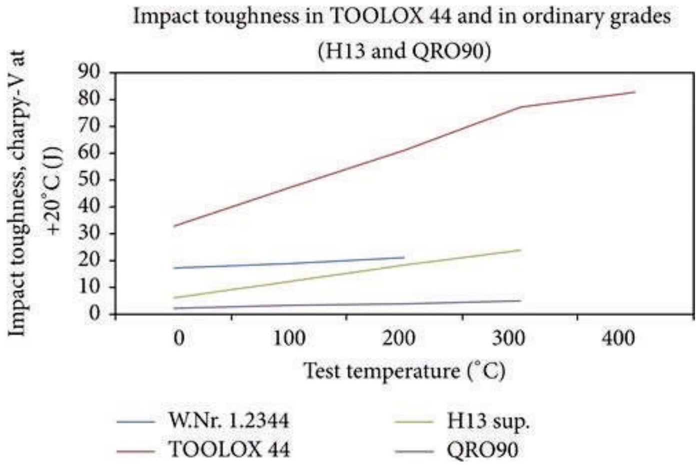
Continued June 2023 issue...

The major failure modes identified for aluminium die casting molds are physical erosion (washout), chemical attack (corrosion), gross cracking (cleavage cracking), and thermal fatigue cracking (heat checking). Erosion occurs when there is a fast flow of molten metal relative to the surface of the die. Usually, gross cracking is harmful and may cause complete cracking of the die. Cracking and fracture of a die occur when the stress on the die material is above the fracture strength (see Figure above). This type of failure is dependent on the nature of the resistance of the die material to brittle fracture, which is termed "fracture toughness" [4, 5]



Die casting mould specimen was produced with TOOLOX 44 (dimensions: 670 mm ×570 mm ×315 mm) The clutch housing mould specimen was manufactured by TOOLOX 44 with the elimination of the heat treatment, as shown in this Figure.

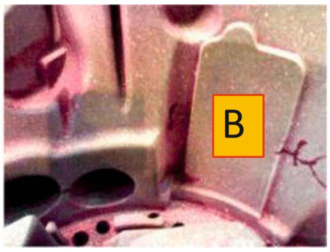


Impact toughness in TOOLOX 44 and in ordinary grades (H13 andQRO90)

Die-casting mould specimen was produced with 1.2343 (dimensions: 670 mm ×570 mm ×315 mm). and the manufactured H11 (1.2343) clutch housing mould specimen with heat treatment is shown in this Figure

TOOLOX 44 exhibits a different cracking pattern compared with H11 (1.2343) after experimental tests done. There are many shallow cracks in H11 (see Figure),

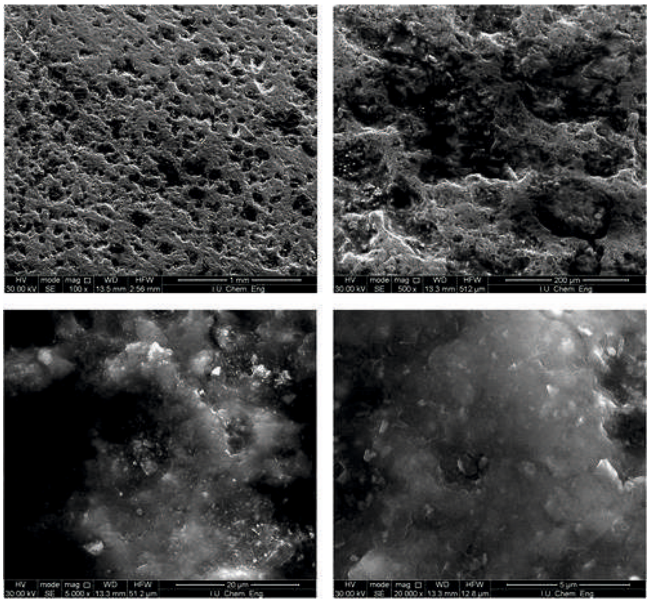
while TOOLOX 44 has fewer cracks with high depth (see Figures A andB).



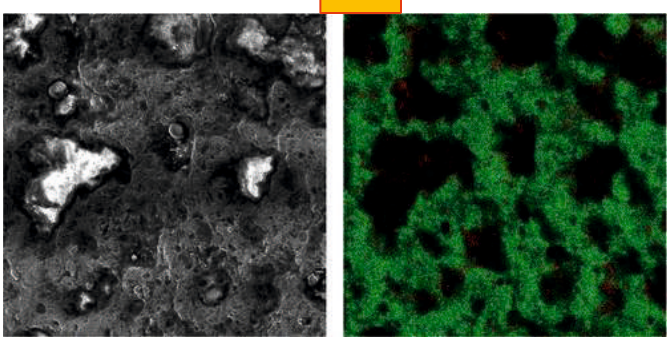
Fracture on the fix side of the die was produced with TOOLOX 44 (After 20,000 cycles' test).

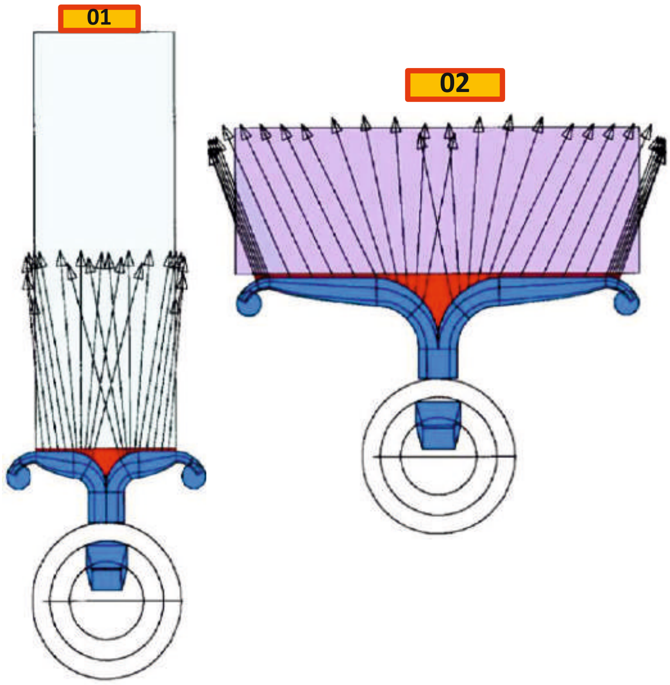
This different cracking pattern is due to soldering and washout damage and the effect of thermal cycling on the TOOLOX 44 microstructure were analysed with SEM as it is shown in Figures C andD.

C

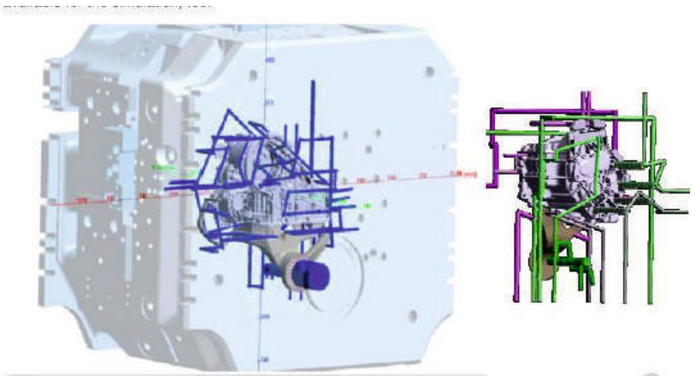


D





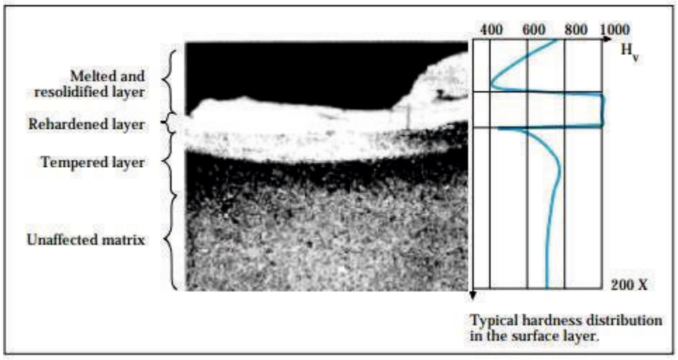
It is better to select the flow in gates such that hot alloy flows shorter distance to reach the complete profile.
Picture 1:
needs high velocity to reach the alloy with sufficient temperature and pressure. This will cause stress on the steel
Picture 2:
This requires just sufficient velocity to reach the ally hot and pack



Typical 3 D model using state of the art modelling tools

Thermal regulation of the die casting die supports:
1) Steel is protected against thermal stress and the die life is assured as well enhanced
2) Reduces the shot cycle time there by operative cost is saved
3) Commodities like air, soluble lube ,water are used in the controlled quantity

EDMAND IT'S EFFECT DURING HEAT TREATMENT



Section from a spark-machined surface showing changes in structure. Material: RIGOR, hardened to 57HRC.

EDM of hardened and tempered material

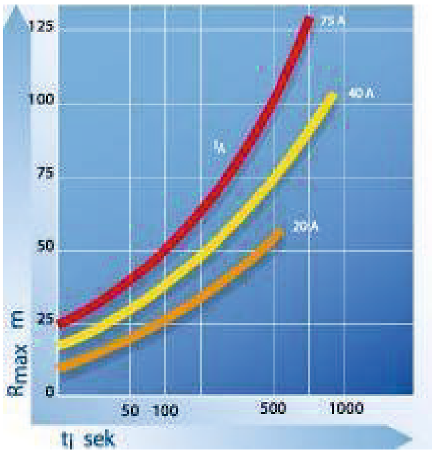
A Conventional machining
B Hardening and tempering
C Initial EDM, avoiding "arcing" and excessive stock removal rates. Finish with "fine-sparking", i.e. low current, high frequency.
D (i) Grind or polish EDM surface
or D (ii) Temper the tool at 15° C (30° F) lower than the original tempering temperature.
or D (iii) Choose a lower starting hardness of the tool to improve overall toughness.

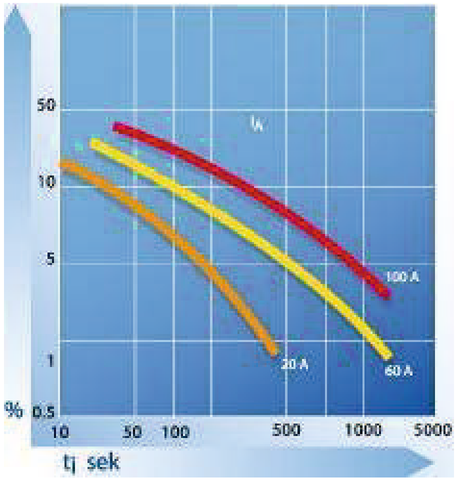
EDM of annealed material

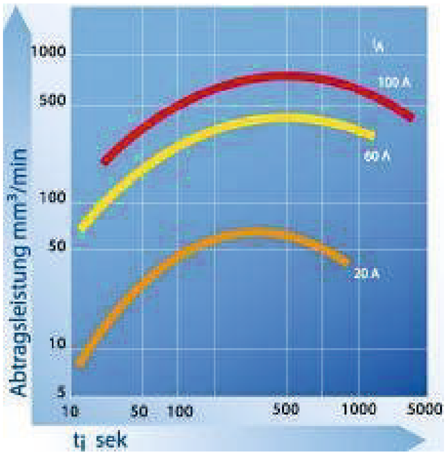
A Conventional machining
B Initial EDM, as C above.
C Grind or polish EDM surface. This reduces the risk of crack formation during heating and quenching. Slow pre-heating , in stages, to the hardening temperature is recommended.

WhenEDM'dinsolutionannealedconditionthetoughnessofCORRAXisnotaffected.
It is recommended that all EDM'ing
It is recommended that the "white layer" is removed by grinding, stoning or polishing.

Spark erosion has a completely different effect on working material than customary methods of processing. The electrical spark hitting the work piece heats up the outer layer of the steel so much (about 10,00010,000°C) that the material evaporates. The metal gases formed then condense in the dielectric, usually in the form of hollow balls, open on one side and having a sharp edge. In the work piece itself depressions, shaped like craters, are formed. How great is the danger for the working material to be so unfavourably affected on the surface, that the serviceability of the tool suffers? And what about tool life, resistance to wear and buffability? Figures 1, 2 and 3 show surface roughness, electrode wear and metal removal in relation to the firing period





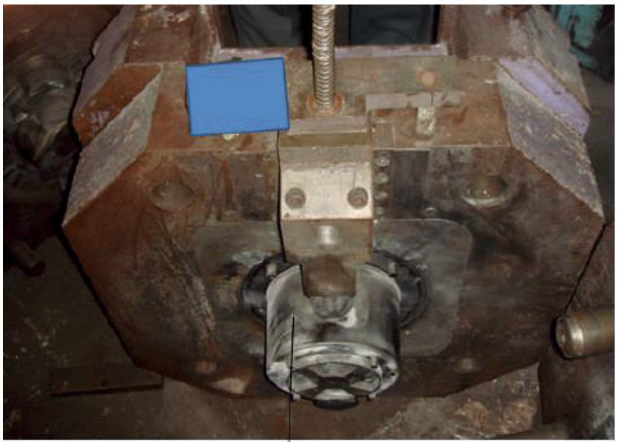


CASE STUDY EXAMPLES

- All the dies manufactured by the toolmaker are not having water cooling arrangements in the appropriate locations of the die.
- Certain cases cooling channels are provided in one

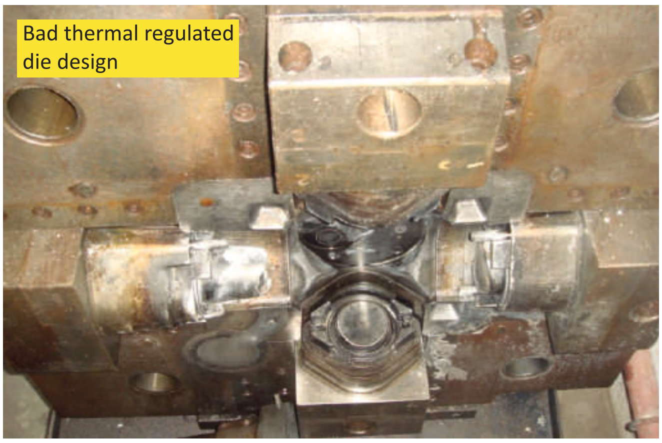
part of the die but not being used during production.

- Gating designs are not for volumetric filling. This will require high pressure to fill the alloy. Hence flash observed in all the components.
- Mechanical core is generally used.
- Steel selection and strength of inserts are good for the smaller dies and not for the bigger dies.

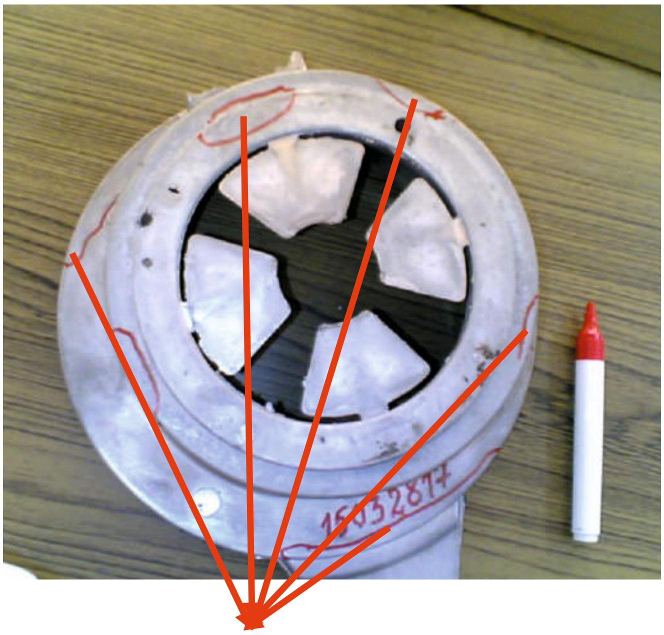


Core is over heated. If cooling is provided this core will produce better part and will have better life.

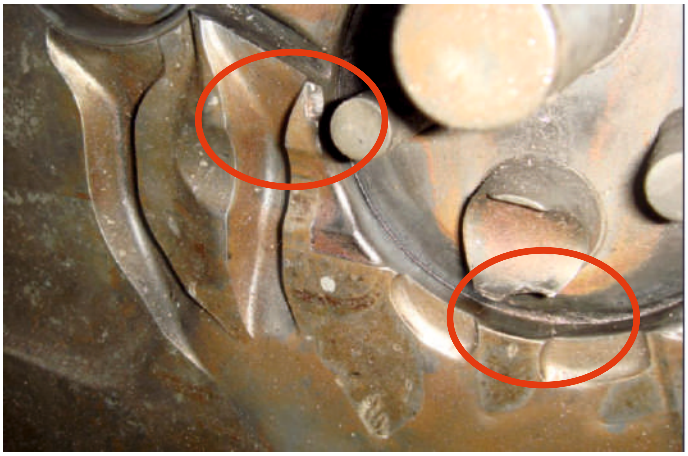
Core is thermally abused during production in the absence of the cooling arrangement.



Flash is observed in the die. Parting line matching has to be checked. If found Ok then the runner & gating design to be improved for better results.

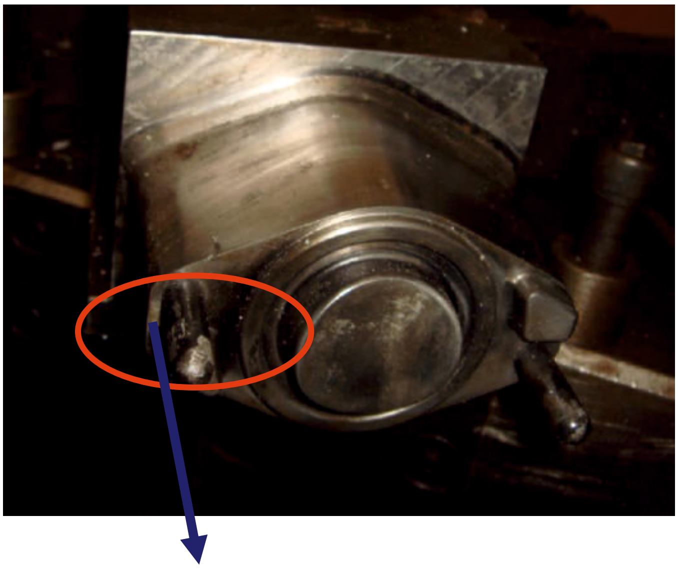


Heat Check marks observed on the component.

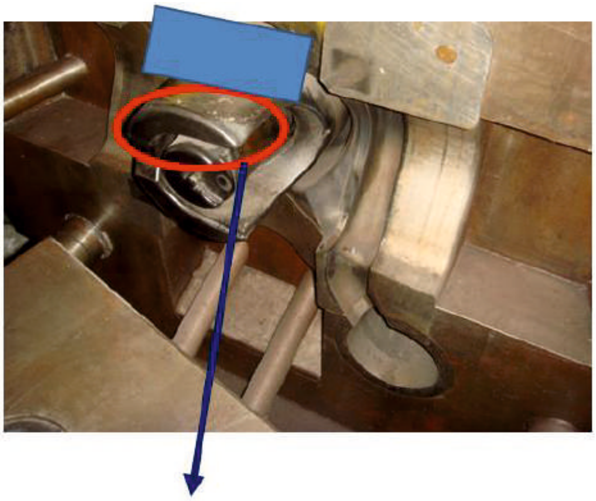


Die chip off & Surface cracks observed

Die chip off & Surface cracks observed



Side core steel is not sufficient from the hole to retain the core pins.Thismay break the side core at early stage.
Either different concept of die design to be adopted or spare should be prepared for eventualities.



Cooling has to be provided to improve the life of the Core insert.

Surface cracks observed in the inserts.

Die crack and heat check marks are decorating the surface finish of the component.

Die is downloaded as the casting has come out of the Fixed die during production run. This due to the cracks and heat check marks on the Die.

Die Design Tool life improvement begins with product design. In particular, sharp edges and corners on a die casting can directly affect die life and tooling costs.
Corresponding sharp corners in the tool act as either stress concentrators or local zones of high heat build-up.
Both conditions can cause premature surface and corner cracking in the tool and shorten tool life.
Therefore, parts should be designed with round edges or generous radii. Gate location also is important, since control of the metal flow in the die cavity is a key factor in producing sound die castings.
Metal must flow rapidly and uniformly into the die, minimizing sharp direction changes that can contribute to premature tool wear.
Flow and solidification software can be used to evaluate and refine the tool design before production begins.
Die Material Premium or Superior Grade H13 tool steel is the starting point for most tool construction.
However, many die casters are realizing significant

improvements in die life using modified versions of H11 steel, heat treated to a hardness level of 48 HRC.

The H11 has higher molybdenum content, with lower silicon and vanadium, providing higher toughness than H13, with good temper resistance that extends die life in demanding applications such as thick-walled castings.

When using H13 steel, it is important to specify either Premium or Superior grades.

These grades are typically made by Vacuum Arc Re melting (VAR) or Electro-Slag Re melting (ESR) of the Standard H13.

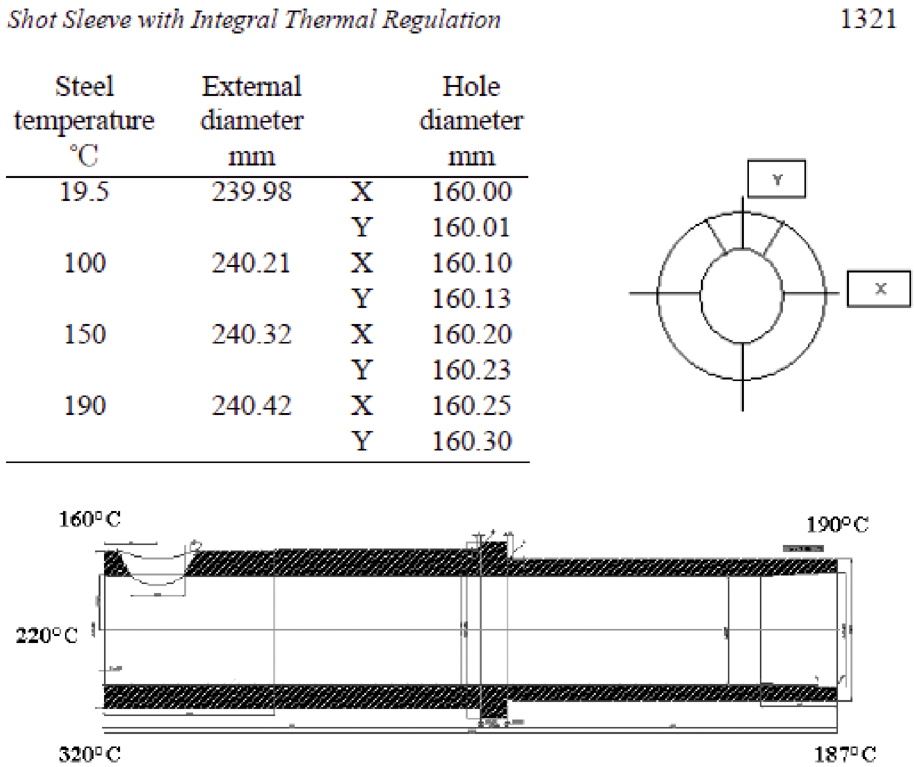
These processes produce superior steel with low sulphur, phosphorous and inclusion content, as well as a tightly controlled carbide size and distribution.

The NADCA 207-2006 Specification for Special Quality Die Steel and Heat Treatment provides detailed guidelines and acceptance criteria for these materials.

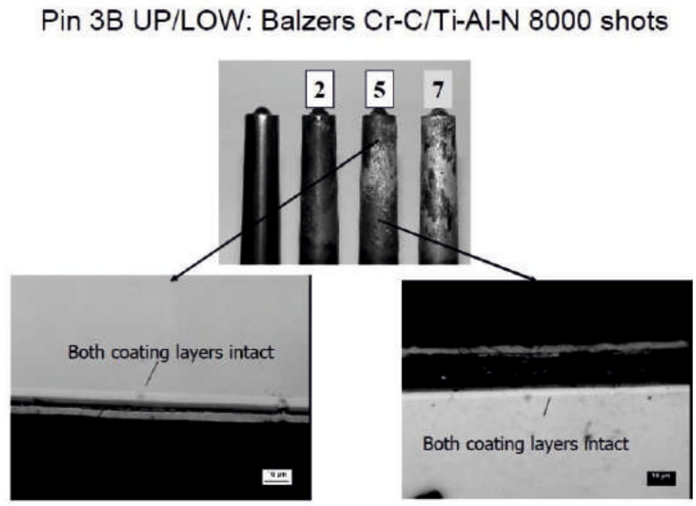
Many die casters also recommend independent testing of the material to ensure it is meeting the minimum Charpyimpact toughness values for the specified grade.

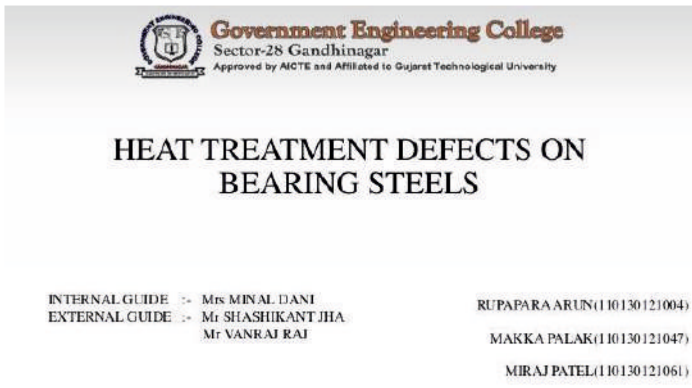
Production –The company vigilantly follows NADCA die setup procedures, paying special attention to the following elements:

- Preheating tools with hot oil to a minimum 250 degrees F measured by internal thermocouples (surface temperature of approximately 300-500 degrees F)
- Pulse cooling water during mould preheat
- Electric heaters used if run downtime is longer than 10 minutes
- Applying mould release spray or cooling spray to appropriate areas to ensure part quality, solder prevention and erosion; gating size and location are a big factor in use of sprays
- Avoiding chippers, chisels or scrappers made of steel; use BeCu where possible
- Verifying all cooling lines and solenoids are functioning properly, and are timed in sequence
- Confirming that clamping pressures are correct and equal among the tie bars


Shot Sleeve with Integral Thermal Regulation 1321

Steel temperature °C	External diameter mm		Hole diameter mm
19.5	239.98	X	160.00
		Y	160.01
100	240.21	X	160.10
		Y	160.13
150	240.32	X	160.20
		Y	160.23
190	240.42	X	160.25
		Y	160.30





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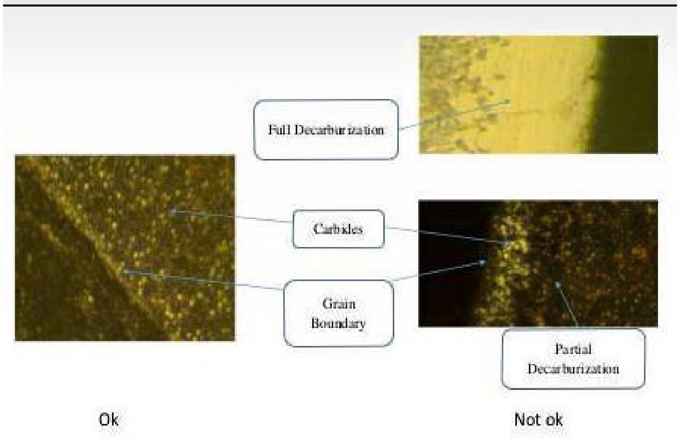


Surface Decarburization

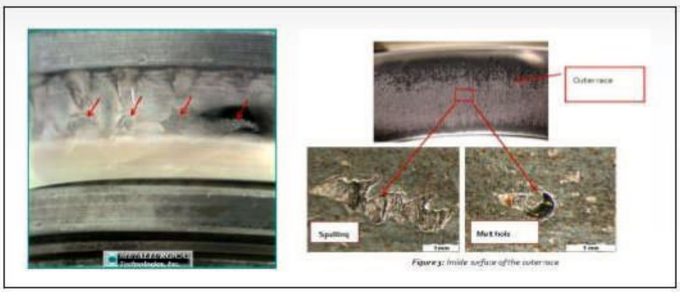
HEAT TREATMENT DEFETS (CONT..)

SOFT SPOT :-

- Furnace Atmosphere
- Poor Quality Quenching Medium
- Dirty Component Surface
- Defective Initial Microstructure

HEAT TREATMENT DEFORMATION :-

- Poor Quality Quenching Medium
- Thermal Gradient before Quenching
- Section Thickness Variation of the Components
- Component's Shape, Dimensions & Position During Quenching
- Agitation of Quenching Medium
- Initial Microstructure of Material



Soft Spots

HEAT TREATMENT DEFECTS (CONT..)

MICRO STRUCTURAL DEFECTS :-

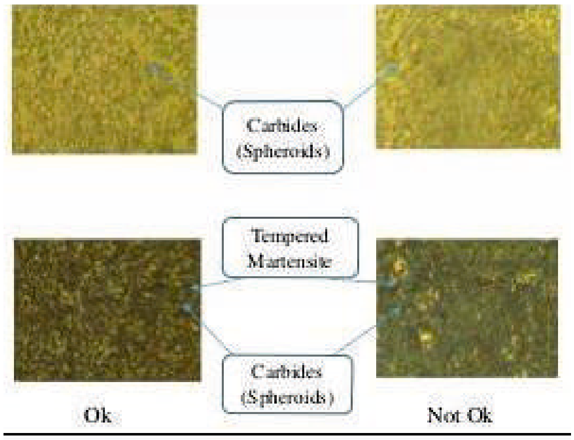
- Non uniform Microstructure
- Unwanted Phase
- Grain Growth
- Grain Boundary Precipitation
- Retained Austenite
- Decarburization

LOW HARDNESS :-

- Lower & Higher Hardening Temperature.
- Heater Failure/Power Failure/Disturb Inert Atmosphere.
- Less Soaking Time During Hardening

HIGH HARDNESS :-

- Lower Soaking Time
- Lower Tempering Temperature



Micro Structural Defects

REMEDIAL MEASURES

Heat Treatment Deformation

- Residual stresses that cause shape change when they exceed material yield strength. This occurs on heating when the strength properties decline.
- Stresses caused by differential expansion due to thermal gradients. These stresses increase with the thermal gradient and cause plastic deformation as the yield strength is exceeded.
- Volume changes due to transformational phase change. These volume changes are contained as residual stress systems until the yield strength is exceeded.

REMEDIAL MEASURES

OVALITY

- Ovality is a certain type of circularity deviation. Ovality results from non-symmetrical distribution of internal tensions before hardening and uneven heating and cooling.
- Devices using very accurate rotational tables or spindles are used to measure circularity. The axis of the component is the measuring base in this method. The measuring device ensures very high accuracy, often better than 1 μm.
- Ovality is checked after Quenching. A special diameter gauge (Figure) that included a dial deviation meter was used to measure ovality.
- Ovality was measured on 10-20 rings so that an ovality deviation was recorded after each rotation. The following procedure was applied :
  - A bearing ring was inserted into the gauge and was rotated manually.
  - A value was read from the deviation meter after each rotation.
- If the deviation was higher than 150 μm, the ring being measured was discarded. It did not meet quality criteria and could not be passed on for subsequent hard machining.

REMEDIAL MEASURE (CONT..)

- QUENCHING CRACK :-
  - Cracks formed by bearing parts in the Quenching process due to internal stress causes Quenching Cracks.
  - Quenching Crack is cause because Quenching heating temperature is too high or too fast cooling.
  - If there's defect in the surface of machining parts that can also lead to Quenching Cracks. Surface decarburization carbide segregation, part quenching or tempering, non-metallic inclusions, previous process (cold punching under stress, sharp edges, forging folding, etc.) are some of the other reasons behind Quenching Cracks.
  - This can cause failure of bearing.
- REMEDIES :-
  - Using oil as quenchant and keeping quenching temperature around 90^{0}C.
  - Reliving internal stress before Heat Treating.

REMEDIAL MEASURES (CONT..)

- SOFT SPOT :-
  - When hardness of surface is not enough it causes Soft Spots.
  - Soft Spot causes because of insufficient heating and bad cooling.
  - This leads to declinations of surface wear resistance and fatigue strength, also bring down hardness.
- REMEDIES :-
  - Avoid formation of oxides
  - Avoid Decarburization

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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
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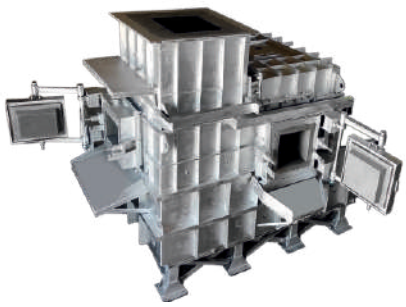
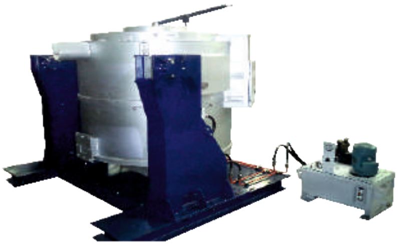
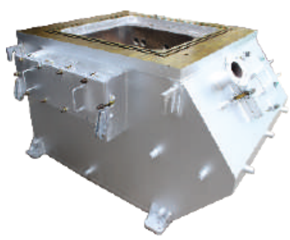
- Increase crucible life
- Easy to remove & replace
- Heater replacement cost will be 40% due to new single leg Design
- Reduce Down time.
- Simple Design

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.**







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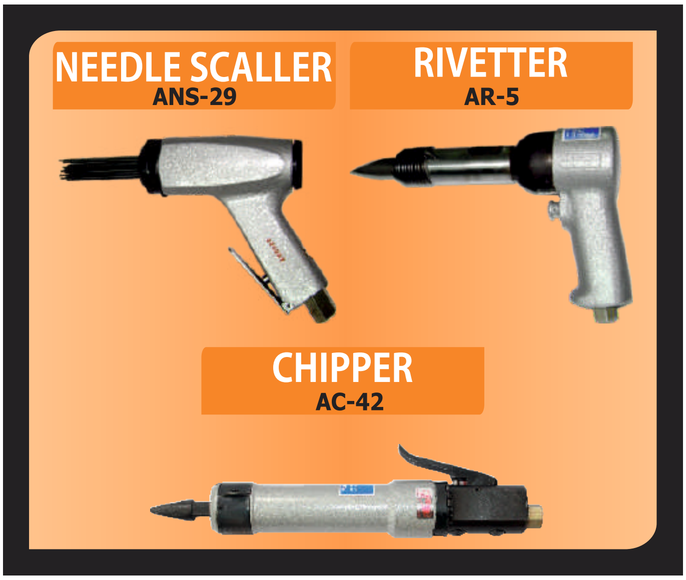

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NEWS

TRAINING PROGRAMMES & QUIZ COMPETITION

Two Days Training Programme On HPDC Die Design, Casting Defects - Analysis and Remedial Measures at Pune, held on 22-23 June 2023
Faculty Mr. Rajesh R. Aggarwal
Quiz competition was also held on 22th June at the same venue. Six teams participated and the winner was **GABRIEL INDIA LIMITED**

Two Days Training Programme On
Melting and Molten Metal Treatment of Aluminium Casting Alloys & Casting Defects - Analysis and Remedial Measures at Aurangabad Held on 29 - 30 June 2023
Faculties V. SRINIVASA RAO
Mr. Pramod Gajare (Chairman - Quiz Committee)
Quiz competition was also held on 29th June at the same venue. Five teams participated and the winner was **ADVANTECH GROUP**

Two Days Training Programme On Core Technology at Pune, held on 25-26 July 2023
Faculty Mr. R. D. Dhumal
Semi final of Quiz competition was also held on 25th July at the same venue. Three teams participated and the winner was **GABRIEL INDIA LIMITED**

Two Days Training Programme On
Melting and Molten Metal Treatment of Aluminium Casting Alloys & Casting Defects - Analysis and Remedial Measures at Ahmedabad Held on 27-28 July 2023
Faculties Mr. R. V. Apshankar
Quiz competition was also held on 27th July at the same venue. Five teams participated and the winner was **SHRIRAM PISTONS & RINGS LTD.**

TECHNOLOGY FEAST

AT

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

TECHNICAL CONTRIBUTIONS BY EXPERTS FROM

Developing Defect Free HPDC Parts by Ensuring Structural Feasibility and Castability Using Simulations and Artificial Intelligence and Machine Learning	ALTAIR ENGINEERING INDIA PVT. LTD.
Low Cost, in-house R & D Innovation Culture – Creating Knowledge Centre	ANAND AUTOMOTIVE (P) LTD.
3D Component – Tomography (NDT & 3D Xray)	BLUE STAR ENGINEERING & ELECTRONICS LTD.
ECO systems, Co2 Foot prints and Sustainability (Green Foundry concept)	BRAKES INDIA LTD.
High speed milling concepts with Dry Miling	BROTHER MACHINERY INDIA PVT. LTD.
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SMARTT –An Innovative Process Control for Rotary Degassing of Aluminium Alloys	FOSECO INDIA LIMITED
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Cost Effective Products for Aluminium Foundry	MORGANITE CRUCIBLE INDIA LIMITED
State of Die Casting in North America	NORTH AMERICAN DIE CASTING ASSOCIATION
Adoption Challenges of 3D Printing and Need for DFAM to Assess Fit for Use	NMINS - SCHOOL OF DESIGN
Prototyping	PAHWA METALTECH PVT. LTD.
Enhance Reliability of Die Casting Machines by Using New Types of Fire Resistant Lubricants	QUAKER HOUGHTON
Investigation of A Patented Technology Based on Ultrasonic Treatment for Aluminum Alloys Casting	REDSHIFT ENGINEERS LLP
Die-casting 4.0 – A Case Study on How Die-casting-operations Can Benefit From Computer Aided Production and Resource Planning and Controlling from Inquiry to Dispatch All on One Standard Platform"	RGU AISA PTE. LTD.
Role of Life Cycle Assessment in The Context of Climate Change and Sustainable Development	SPHERA SOLUTIONS GmbH
Optimization of Heat Treatment Process for Aluminium Alloys	TRANSVALOR
Energy & Waste Reduction	TVARIT GMBH

* Subject to change..

"We thank all experts who have confirmed their participation well in advance"

THIS WILL HELP INDUSTRY TO PLAN FOR PARTICIPATION

CONCURRENT EVENTS

International Conference & Exhibition

1-2-3 December 2023

at Chennai Trade Centre, Chennai, India

ALUMINIUM DIECASTING EXHIBITION & CONFERENCE

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for Diecasting Industry

for Forging Industry

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