ALUMINIUM GDC TECH GREAT DIE CASTING

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JOURNAL FOR ALUMINIUM CASTING TECHNOLOGY

Volume 63 - April 2024

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ALUMINIUM GDC TECH GREAT DIE CASTING

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

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'Guruprasad', 1st Floor, 37/4/A, 6th Lane, Prabhat Road, Pune 411 004 INDIA
Tel: +91 20 2567 0808, 2567 2555 | Mobile: +91 9764711315
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Note: Some images in some articles may not be clear. Interested readers may contact the author

CASE STUDY

DIAMANT* TURBO ROTOR

ALUMINIUM FOUNDRY
NON-FERROUS METAL TREATMENT

FOSECO

Superior melt treatment and quality through high performance degassing rotors

INNOVATION & TECHNOLOGY

THE CHALLENGE

High production aluminium wheel foundry supplying OEM customers in Asia. Urgent foundry need for increased productivity in the melt treatment area and improved melt quality to meet escalating cost and quality demands from automotive end-users. The current high foundry production capacity utilization and a demanding metallurgical specification combines to put high pressure on the existing melt treatment process.

FOUNDRY:
Low Pressure Wheel foundry

PARAMETER

Alloy: A356 - AlSi7%Mg0.3%
Ladle capacity: 800 kg
Temperature: 720 °C
Treatment cycle time: 10 min
Treatments per day: 120

FOSECO PRODUCTS

DIAMANT TURBO rotor

MTS 1500 metal treatment station
Type Rotostativ

COVERAL* MTS 1565 cleaning flux

VESUVIUS

go to next page

OUR SOLUTION

Faced with these challenges, our innovative solution emerged: the DIAMANT TURBO rotor.
This new rotor utilizes a novel, patented pumping rotor design resulting from extensive flow simulation modeling and melt testing in Foseco R&D, and is manufactured in a special oxidation-resistant graphite composite material which ensures long life compared to machined graphite.

KEY BENEFITS

- **Reduced treatment cycle time by 40%**
- **Degasser rotation speed reduced by 100rpm**
  >> extended rotor and shaft life
- **Cleaner melt**
  >> reduced pores and inclusions

> LET´S LEARN MORE

THE OUTCOME

Foundry melt quality target achieved (Density index > 2.62) with reduced cycle time and lower degassing rotation speed. Subsequent metallurgical analysis indicated a 75% reduction in oxide inclusions and porosity in the treated melt compared to the current practice.

Rotor after treatment

Rotor during melt treatment

THINK BEYOND. SHAPE THE FUTURE.

FOSECO

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Die design solutions for meeting challenges for future casting technologies

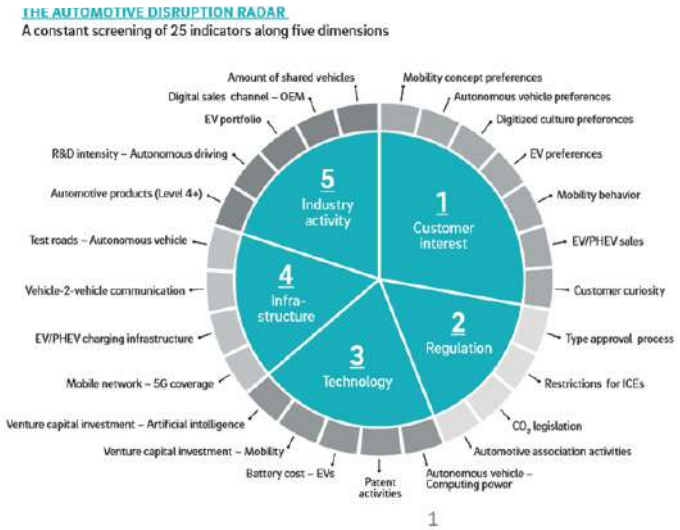
Jayesh Rathod, Sr. General Manager, Godrej & Boyce Mfg. Co. Ltd., E-mail: jmr@godrej.com

Over the past 130 years, the automotive industry has followed a very "linear" development path. But due to the parallel emergence of four megatrends in the last 2 years (MADE – Mobility, Automated driving, Digital experience, Electrification), the industry is likely to be reshaped in the next 10 to 15 years." Market disruptions are causing major changes in the Automotive ecosystem. Changes are happening at a faster pace than envisaged. Die casting field is no exception. These disruptions are caused by Customer interest, Regulation, Technology changes, Infrastructure and Industry activity. Each of the above 5 dimensions of disruptions can entirely change the mobility preference of customers. EVs and Auto-driven cars are the initial indicators of the changes in the entire landscape of the auto industry. Both the category of vehicleseither developed owing to regulatory compulsion or owing to technological changes. This in turn will affect the infrastructure requirement and will initiate industry activity of R&D of autonomous driving and digital manufacturing.

Market dynamics should be monitored and analyzed permanently, with a strong focus on major tipping points. Die casting being a leading mass production process of Automotive industry will also go through overhaul in terms of Material, Process, Technology and Equipment. The newer technology in Die casting should provide solutions for unthinkable products. The below given paper will detail about readiness of Die casting industry through Die design solutions to adopt the rapidly changing technology and provide viable solution to customers

The green environment is the need of the hour and every responsible corporate is engaged in contributing their bit through development of new processes, products, techniques and wants to become Power and Water positive entity. The market disruptions are initiating hoard of changes in R&D, Product Designs and Manufacturing processes.

The 25 indicators of disruption are detailed out in Fig. 1 acts as pointers monitoring the changes for future readiness.



1

Auto industries have major contribution in emission of green-house gases through their products and processes.

It is inevitable for this mother industry to contribute in a major way to negate the impact and provide environment friendly mobility solutions.

Figure 2 shows 5 avenues of making greener Automobile.

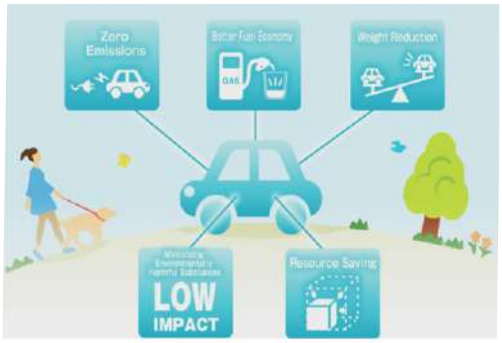


Figure 2

Zero Emissions and minimizing environmentally harmful substances will have solutions through technological advancement.

Whereas Better Fuel Economy and Resource saving will have root into Light weighting aspect of Automobile Engineering.

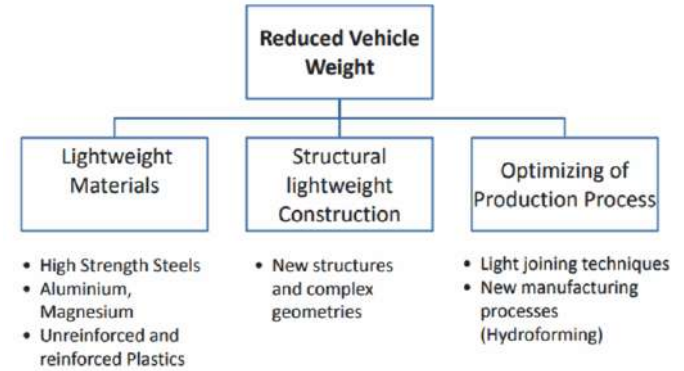


Figure 3

The Reduction in weight of Vehicles can be achieved by 3 methods as indicated in Figure 3.

With respect to Aluminium Die cast parts we will look into first 2 methods in details and understand the specific die design considerations to be made.

Light Weight Materials:

The basic criteria of qualifying product design as Lightweight is its wall thickness. It's a relative term and the value of thickness depends on the size of part. As a general guidelines thickness reduction of 25% - 30% with respect to standard thickness can be termed as lightweight casting. The below given sketch describes the same.

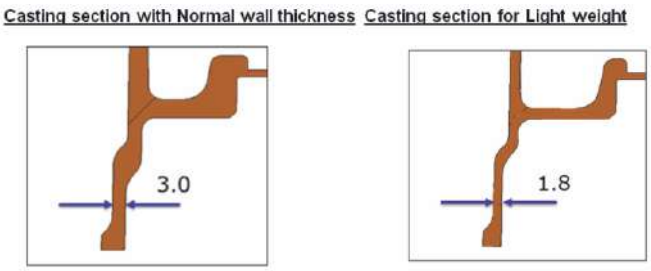


Figure 4Section Thickness

Casting with wall thickness of 1.8 mm can be termed as lightweight when the part size is in the range of 1300 mm x 1200 mm. Such examples of a structure part are shown below.

Fig. 5 Example of Large Lightweight Die cast part for Automobile

Owing to less casting volume the die inserts does not retain requisite heat necessary for Aluminium flow. This needs external source of heating through Hot Oil Channels in Inserts and Die blocks.

The molten Aluminium temperature in the furnace to be maintained at 700 °C for ADC 10/12 alloy and lesser temperature for ADC 6. It should be ensured that shot sleeve temperature is 230°C at pouring point. This will compensate for heat loss during melt travel through thinner sections.

The die insert temperature of minimum 170 – 200°C after spray to be maintained by circulating the Hot oil at 200 – 250°C.

The Die blocks should be heated separately to maintain temperature of 150°C.

The external heating of Die blocks causes more thermal expansion in large dies making the usage of round pin and bush difficult. It is advisable to use rectangular guides for smooth operation of dies on hot condition.

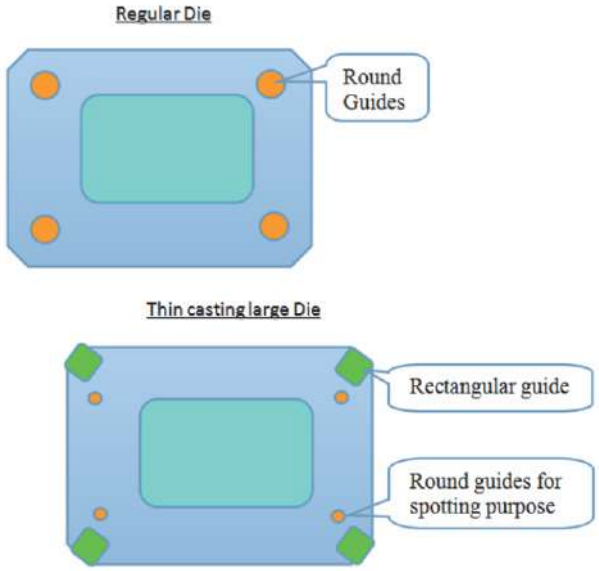


Fig. 6Guiding arrangement for Die blocks of Light weight castings

Additional round guides are added with rectangular guides for ease of spotting in cold condition. It must be removed in operation to avoid redundancy.

The heat extraction requirement of each zone of a large die will be different. Separate oil circuits to be provided for each temperature zone and oil to be circulated at +50 °C to take care of heat loss.

As a guideline oil circulating from bearing area should be at 200°C whereas in the component forming area it should be 60°C.

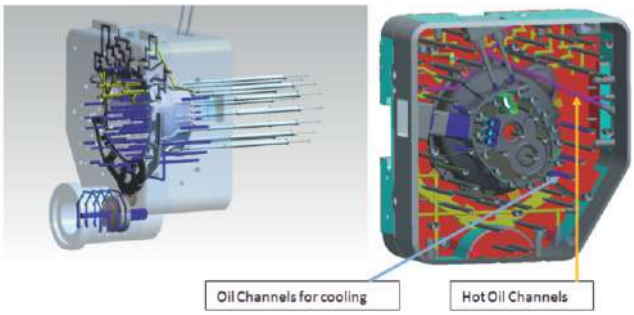


Fig. 7 Separate oil circuits for each thermal zone

Feeding System Design –

For thinner parts the fluidity of Aluminium will be less in the die. This will results in non-filling at difficult to reach and low temperature area. The metal will solidify quite early needing very high operating parameters for filling.

The higher Casting injection pressure in the range of 400 ~ 500 kg/cm² should be considered for all calculations.

Shorter Fill time will take care of lesser temperature

drop during filling. As a guidelines it should be taken as 80% of normal Al fill time while deciding on gate sizes.

Example: For 3mm casting fill time is 0.045 sec For 1.8mm casting fill time is 0.036 sec For Magnesium alloys filling time should be 70% of value calculated for Aluminium casting with 3 mm thickness.

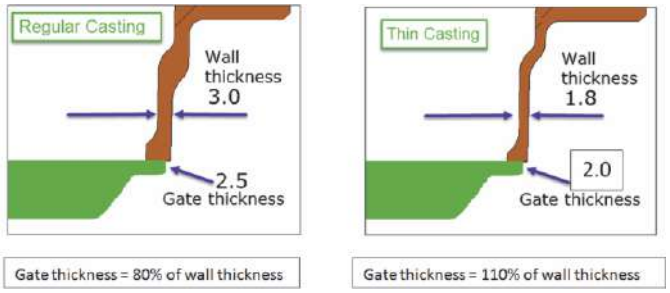
Next parameter to be critically maintained is higher plunger velocity (V2) since we are aiming for faster cavity filling. It should be decided to achieve the above fill time parameters.

Gate velocity to be aimed at lesser than 40 m/sec to avoid erosion effect. This can be achieved by increasing gate area.

The fill ratio to be maintained at generic value of 35 – 40%. The above parameters will lead to the most critical Gate design values.

Care should be taken that there are no long metal flow path. If it persists then add more number of gates to reduce temperature drop.

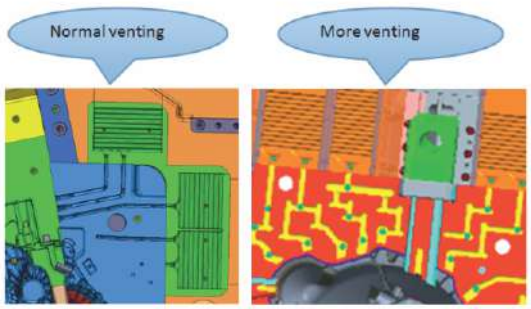
1. For thin Al casting more gate area is required. The gate thickness should be 10% more than casting section thickness. This is a change from normal 15% less thickness of gate than casting section.



Venting System Design -

The critical parameters considered for Feeding system design can be realised if there are no major restriction of back pressure during filling.

For normal design 50% of gate area is considered for venting design. For light weight castings we are aiming to achieve lesser fill time through 80% of ingate area as venting area. Vacuum assisted filling should be extensively used to get sound castings.



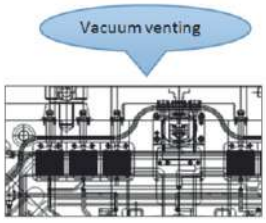


Fig. 9 Venting Design guidelines for Light weight castings

Structural Light Weight Construction:

The structural castings have altogether different characteristics that needs specific consideration for Die design and usage. Though these are yet to be introduced and put in regular production in our domestic foundries. We must understand the basics of such castings.

High 'Fe' content prevents traditional die casting alloys from achieving high mechanical properties, especially elongation.The 'Fe' content helps to avoid die soldering.

Fig. 10 Aluminium Alloys for Structural castings

The specifically developed alloys as given above in Fig. 10 to meet the below given characteristic adds to the complexity in Die design and design related calculations.

Structural castings usually have,

- Large area
- Thin wall
- Complex geometry
- To be heat treatable
- To be joint by welding or riveting
- Need high fatigue and impact strength

Fig. 11Examples of Structural Castings

All the above characteristics becomes inputs for Die design calculations. Let us understand impact of each characteristics and the probable solutions to overcome the same.

Larger area of castings with relatively thinner walls:

To achieve the above criterias we must understand the critical factors that will lead to success in obtaining the desired results.

- Understanding the behavior of material during flow and solidification phase in thinner sections
- How to avoid alloy temperature drop before complete filling
- Protecting Die life under higher pressure condition
- Ejecting thin walled casting without casting deformation and war page
- How to avoid shot sleeve erosion

In order to fill the cavity in a shortest possible time and maintaining gate velocity within recommended limit of 40-60 m/sec we have to provide maximum number of gates at all the possible locations covering most areas of castings. The below given image Fig. 11 demonstrates the same.

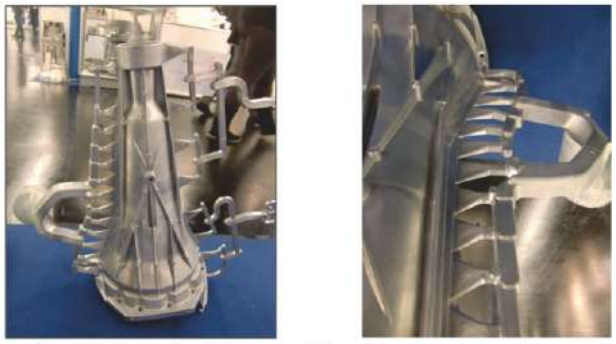


Fig. 11Gating Design in Large and thin wall casting

Complex geometry of Castings:

The thin wall structural castings will have many ribbing and dip features that results in thinner sections in Die inserts. These thin inserts pick up heat very fast during material flow and cause soldering and other casting defects. Die design to include provision for faster cooling of these inserts.

For ultra-thin sections where conventional method of cooling cannot be provided, conformal cooling to be planned. These can be provided by applying latest technology of 3 D Printing. Ref. Fig. 12

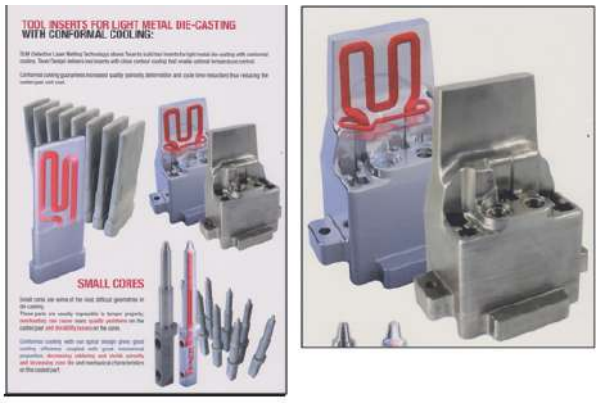
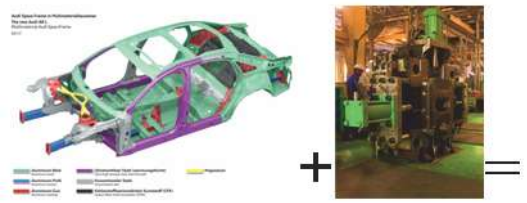


Fig. 12Conformal cooling for thin and slender cores

The Light weighting of castings are challenge to Die designer and Die caster. Following points need to be understood well by both to achieve the desired results.

- Foundry should meet the higher temperature conditions, shorter filling time, higher first phase velocity with healthy Diecasting machines.
- Thicker gates are real challenges to get during trimming and fettling.
- Vacuum assisted venting is one of the condition for producing Good thin walled castings. It needs well-built dies with proper parting line sealing and good maintenance practices.
- Operating almost at the threshold limit of all parameters Die life takes its toll and as a guideline one should consider 20% less die life than normal conditions.

Final Product to meet the aspirations



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INNOVATION

Vishwas Kale, Managing Director, Vijayesh Instruments Pvt Ltd, Pune
vish1945@gmail.com

Innovation is a new idea, more effective device or process. Innovation can be viewed as the application of better solutions that meet new requirements, inarticulate needs, or existing market needs. This is accomplished through more effective products, processes, services, technologies, or ideas that are readily available to markets, governments and society. The term innovation can be defined as something original and more effective and, as a consequence, new, that "breaks into" the market or society. While a novel device is often described as an innovation, in economics, management science, and other fields of practice and analysis innovation is generally considered to be a process that brings together various novel ideas in a way that they have an impact on society.

Innovation changes an idea or invention into goods or services that creates value or for which customers will pay. An idea must be replicable at an economical cost and must satisfy a specific need, then only it is an innovation. In business, innovation often results when ideas are applied by the company in order to further satisfy the needs and expectations of the customers.

Two Categories of Innovations

1) Evolutionary innovations(continuous or dynamic evolutionary innovation): These are brought about by many incremental advances in technology or processes

2) Revolutionary innovations(also called discontinuous innovations) which are often disruptive and new.

Innovation is synonymous with risk-taking. Organizations which create revolutionary products or technologies face the greatest risk because these create new markets.

Innovation leadership is a philosophy and technique in itself. This motivates employees to produce creative ideas, products, and services. The key role in the practice of innovation leadership is the innovation leader. It is necessary for organizations to think innovatively to ensure continued success and remain competitive. Without innovation leadership, organizations are likely to struggle. The traditional view of organizational practices, which discouraged employee innovative behaviours is now changed. It now values innovative thinking as a potentially powerful influence on organizational working.

A leader needs to promote a safe environment for employees to put forth novel ideas. He should also provide them with the resources to do so effectively. Open leadership should send a message that unconventional ideas are not only accepted but also encouraged.

Evaluation of Idea and its Implementation

In addition to providing a climate for idea generation, innovation leadership also needs leaders to ensure that the process of idea generation does not cast shadows on the evaluation and implementation processes. During these phases of leadership, leaders must support some ideas while discarding other ideas and put the supported ideas into production. The role of the leader must shift away from a transformational style to a more transactional style of leadership. This involves being more direct and critical toward the ideas generated. A leader needs to ensure that constructive discussions of innovative ideas are taking place among their subordinates. This serves to evaluate the usefulness of each idea. Also eliminate those that do not appear viable to the organization or goal. This also pushes the ideas that do appear viable into the production phase. The leader must have closed leadership behaviors to achieve this. Instead of stimulating idea generation, the leader must shift focus from generating new ideas toward fine-tuning existing ideas. This will achieve progress toward the goal, and ultimately implement the idea. This challenge of balancing differing leadership styles when appropriate is called the generator evaluator paradox. It is important to consider the role of ambidextrous leadership. A leader must be able to switch between leadership roles and styles when necessary to successfully lead for innovation.

The technological innovation system is a concept developed within the scientific field of innovation studies. The approach may be applied to at least

three levels of analysis: to a technology in the sense of a knowledge field, to aproduct or an artifact, or to a set of related products and artifacts aimed at satisfying a particular function. The approach has especially proven itself in explaining how sustainable energy technologies have developed to diffuse into a society, or also failed to do so.

The entrepreneur has to transform knowledge into business opportunities, and eventually innovations. The entrepreneur can do this by performing market-oriented experiments that establish change, for the emerging technology. He should ensure about knowledge diffusion in all those involved in the process by meetings, workshops and conferences. Emerging technologies cannot be expected to compete with incumbent technologies. In order to stimulate innovation, it is usually necessary to create artificial or niche markets. Resource Mobilization refers to the allocation of financial, material and human capital. The access to such capital factors is necessary for all other developments. Typical activities involved in this system function are investments and subsidies.

The rise of an emerging technology often leads to resistance from persons with interests in the incumbent energy system. In order for a Technological Innovation System to develop, other persons must counteract this inertia. This can be done by urging authorities to reorganize the institutional configuration of the system.

A disruptive innovation is an innovation that helps create a new market and value network, and eventually disrupts an existing market and value network over a few years, displacing earlier technology. In contrast to disruptive innovation, a sustaining innovation does not create new markets or value networks but rather only evolves existing ones with better value, allowing the firms within to compete against each other's sustaining improvements. Sustaining innovations are innovations in technology, whereas disruptive innovations cause changes to markets. For example, the automobile was a revolutionary technological innovation, but it was not a disruptive innovation, because early automobiles were expensive luxury items that did not disrupt the market for horse-drawn vehicles. The market for transportation essentially remained intact until the debut of the lower-priced Ford Model T in 1908. The mass-produced automobile was a disruptive innovation, because it changed the transportation market. The automobile, by itself, was not.

Competitive intelligence is the action of defining, gathering, analyzing, and distributing intelligence about products, customers, competitors, and any aspect of the environment needed to support executives and managers making strategic decisions for an organization.

Competitive intelligence essentially means understanding and learning what's happening in the world outside your business so one can be as competitive as possible. It means learning as much as possible, as soon as possible, about one's industry, competitors, county's rules. It empowers you to anticipate and face challenges straight head on.

It is always better be innovative and progress further.

MEMBERS ACHIEVEMENT

Aakar Foundry was awarded the Best Kaizen Award in the 18th Bajaj Auto Kaizen competition. Out of a total of 92 Kaizens submitted, 32 were selected and finally, 3 were awarded.

UNO MINDA Has been Awarded by Honda for best performance in Delivery performance.

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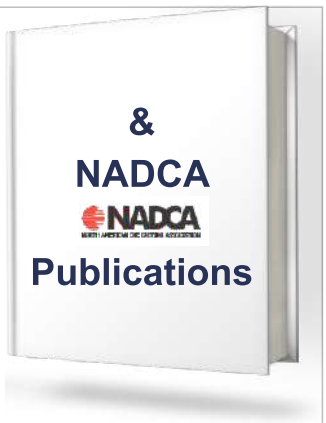

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GREAT DIECASTING TECHNOLOGY FORUM

CELEBRATION

International Women's Day

"Women's Day" was celebrated on Saturday 9th March 2024 at Prabhat Road office of Great Die Casting Technology (GDC Tech) Forum. On this occasion, the accomplished women of Pune and Tamil Nadu were honored in the field of Die Casting.

The die casting industry has always been dominated by men. The nature of work is also hard work. A select few women have established themselves in such fields with their invaluable work and perseverance. This felicitation ceremony is held every year to honor them.

In this ceremony Mrs. Ujwala Gosavi, head of 'Climber Group' presided over the program. Mrs. Bharathi Aruchamy, Director of 'Jaya Nidhi Automatic', Coimbatore, Mrs. Renuka Maragudri, Senior Engineer at 'Aakhar Foundry', Mrs. Sangita Sagaokar, Founder at 'Praneet Engineering Works', Mrs. Harshada Musale, Quality Worker at 'Uno Minda' Company, Mrs. Sayli Patil, Senior Manager at 'TSS Group', and Mrs. Pooja Sapre, Director at 'Impression Auto Components', were felicitated women in die casting.

The GDC Tech Forum this year invited women in the die casting industry to write about their journey and experiences in the industry. Many women participated in this. All the articles were very inspiring. After a painstaking selection from many entries, Mrs. Sangita Sagaokar, Praneet Engineering Works and Mrs. Bharathi Aruchamy, Jai Nidhi Automation were awarded the "Inspiring Entrepreneur in Die Casting"; While Mrs. Sayli Patil, TSS Group, Metallica Alliance Co. & Machine Tech and Mrs. Renuka Maragudri, Aakar Foundry Pvt Ltd was awarded "Inspirational Engineer in Die Casting". Mr. R. T. Kulkarni announced the award.

On this occasion in an interview program conducted by Pramod Gajare, the honored women presented their experiences and challenges in the field of die casting to the audience. Gave good guidance on how more and more girls can get the opportunity to get high position in this field.

Mr. Anil Kulkarni Chairman of GDC Tech Forum welcomed all the dignitaries. Mr. Apashankar introduced the chief guests. Mr. Jitendra Lakhotia thanked the attendees. Mr. Vaibhav Karmarkar moderated the program.

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GREAT DIECASTING TECHNOLOGY FORUM

CONSTITUTION OF NEW EXECUTIVE BOARD 2024 - 2027
ANNUAL GENERAL MEETING HELD ON 2ND MARCH 2024

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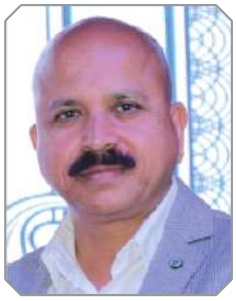

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Past President

THIS IS OUR GDCTECH

Pramod Gajare, Consultant, pramodgajare2013@gmail.com

In last monsoon we were discussing about Great Die Casting Technology Forum completing ten years. The journey of a decade was encouraging and demanding further more. On this occasion an idea came to pen a song on activities of the forum and the known and unknown members of the GDCTech.
Since the activities of the forum are multifaceted it was challenging to explain them in the form of song. When focused on the purpose of the forum, the ideas became clear and clear. Then on 3rd August 2023 evening I wrote this song.

Our forum is a journey; a never-ending journey for knowledge dissemination amongst the industry for betterment of Aluminium die casting industry and thereby progress of the nation. In the deccan region of India we have a legacy of a great journey which dates back to about four centuries. This pilgrimage is called as 'Wari'. It starts in the month of 'Aashaadha' as per Indian calendar from various locations and reaches 'Pandharpur' – the holy place of 'Lord Vitthala'. Over millions of people – the Warkari – walk continuously for about three weeks with a common motive of having eternal peace through the 'Darshan' of the God.

The theme of this song is influenced by this journey, which is made for no materialistic gains. Our members who contribute to the forum are the 'Warkari of modern era' who aim for giving back to the society and get satisfaction through it. This song is salute to all such Warkari of the forum.

From centuries the Warkari chant the Owees and Abhangas - the traditional forms of songs – of the Lord Vitthala, which are scripted by respected holy Saints; some known and some unknown. With a very little wisdom that I possess, I dared to use the language and words used by these saints to explain the forum's activities in a simple manner.
I wish this journey of our forum would continue without any interruption from one generation to the other.

हे आपले जीडीसीटेक
इथे जमते सगळी
जाणकारांची मांदियाळी
नियोजन करीती वेळोवेळी

विविधांगी कार्ये अनेक
गुंफला रेशीमगोफ एक
हे आपले जीडीसीटेक

आयुष्ये वेचिले संचित
देणे समाजाचे जाणुन
देती श्रममंदीरी वाटुन

टाकुन लडी अग्नीकुंडात
निगुतीने द्यावी आच
रस नसावा अति लोहित

मुशीत योजावे शोधन
ढवळुन काढावे हीण
रसायनाचे मर्म जाण

लिलया ओतुन साच्यात
ऐवज काढावा चोख
अंतरंगी न येई व्यंग

युवा शिकती तंत्रज्ञान
येई जेव्हा आत्मभान
मुखी झळके समाधान

थोरामोठ्यांकडुन ऐकविती
युक्तीच्या गोष्टी परिसंवादात
उद्योग उदीम वाढो देशात

जगी काय ते नवीन
प्रगतीचा मंत्र जाण
यास्तव घडविती देशाटन

विविधांगी कार्ये अनेक
गुंफला रेशीमगोफ एक
हे आपले जीडीसीटेक

Following is the synopsis of this song.

he people from industry - knowledgeable in various fields of Aluminium die casting – come together, meet frequently and plan their activities from time to time. They form a Silk-Thread of various activities; this is our GDCTech.

The knowledge gained through the life time experience is now to be returned to the society; specially at the foundries which are in true sense Temples of Work.

The training includes various aspects of Aluminium die casting.

It starts with the Furnaces, Crucibles, ingots of Alloys, melting practices, focus to avoid overheating of the melt.

Molten metal to be cleaned and the dross is to be removed through proper rabbling. Various chemicals are to be used for metal treatment i.e. grain refinement and modification. It further emphasizes important of die design, process control and defect prevention. The youngsters get self-realization when they go through such training programs.

They now know the real meaning of what they are doing on the shop floor. Their faces glow with satisfaction.

Conferences are arranged regularly and stalwarts from industry are invited.

They share their knowledge in various aspects of the industry.

The new things that are happening across the world are the catalysts for growth. Visits to International exhibitions and renowned foundries help the Indian industries to progress further.

- -

GDCTECH CROSSWORD #1
THE CUE: WARMUP

Compiled by: Pramod Gajare Consultant (pramodgajare2013@gmail.com)

Solution to GDCTECH Crossword #1

Ref: Feb 2024 Issue

H	1	3								G	I	F	A	
P		D							M	R				
D		P		B	A	U	X	I	T	E	E			D
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D	M	I	C	R	O	S	T	R	U	C	T	U	R	E
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IMPORTANCE OF CASTING SIMULATION FOR ALUMINIUM INDUSTRY

Amit A Tingare, Divisional Manager - Aakar Foundry, Pune | Email: amit.tingare@aakarfoundry.com

Synopsis - Managing the complexities of casting molten metal can be tough, especially during production challenges. Simulation software helps by spotting defects early in the design phase, cutting down trial runs, saving time, and reducing costs. Nowadays, casting simulation is important for understanding moulds filling, material solidification, and temperatures Distribution, predicting issues like shrinkage porosity and hot spots.
Overall, casting simulation has become an indispensable tool for improving the quality, efficiency, and cost-effectiveness of casting processes in various industries, including automotive, aerospace, and manufacturing.

1. INTRODUCTION:

Simulation enables foundry professionals to fully experiment with their casting processes virtually, predicting defects in the early stages of the design cycle.

Accurate prediction of simulation results and quantification of defects, along with appropriate process design, are crucial for achieving "First Time Right" approach during production trials.

Casting process simulation utilizes numerical methods to measure cast component quality by considering factors such as mould filling, solidification, cooling, and providing quantitative predictions of mechanical properties, thermal stresses, and distortion.

By utilizing casting simulation software, manufacturers can make adjustments to the mould, tool design, or casting process and simulate the outcomes in a virtual environment before implementing any tool Design, corrections in old Tools.

Incorporating real-world data into simulations enhances accuracy, ensuring that the virtual representation closely mirrors actual production conditions. Continuous improvement in simulation techniques and software capabilities drives innovation in casting processes, leading to higher-quality products and streamlined production workflows.

Effective utilization of simulation technology empowers foundries to stay competitive in today's dynamic manufacturing landscape.

2. WHY SIMULATION IS NEEDED:

Historically, the foundry industry relied heavily on practical methodologies for mould design and casting process optimization due to the absence of sophisticated software tools.

Mould construction and casting processes were primarily guided by the accumulated practical experience of foundry personnel, often resulting in a labour-intensive and iterative approach.

Numerous trial runs and manual adjustments were necessary to achieve desired casting outcomes, leading to significant time, cost, and resource expenditures.

Thus, Simulation Tool is so popular because of its wide range of benefits.

- Enhance the quality of the casting.
- Reduces Errors as well Defects.
- Help to optimize Design & process parameters.
- Reduce Time & Cost.
- Increase efficiency & Productivity.
- Reduces mould corrections.

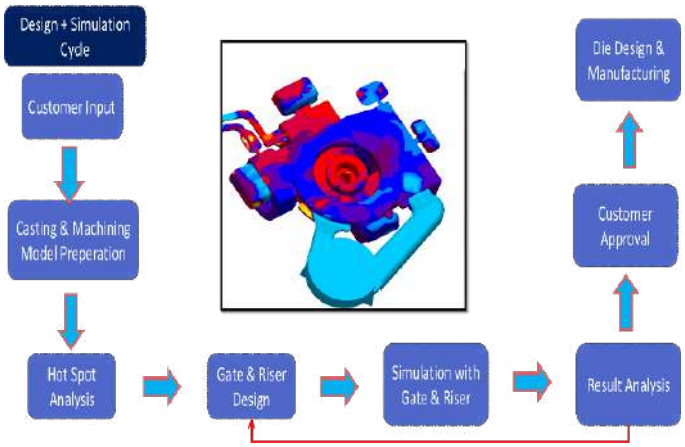
3. BENEFITS OF SIMULATION:

Casting simulation significantly enhances both the efficiency and quality of the casting process. By conducting simulation analyses, manufacturers can proactively identify and address potential defects during the design phase, thereby minimizing errors and improving overall casting quality.

The technology enables manufacturers to predict and mitigate common defects such as porosity, hot spots, shrinkage, and non-filling before initiating the tool manufacturing process. By identifying root causes of casting defects, manufacturers can take proactive measures to optimize the casting process and ensure superior quality outcomes.

Simulation also aids tool designers in optimizing gating and riser system designs, consequently enhancing casting yield and reducing defects. Moreover, it allows for the identification of optimal process parameters like pouring temperature and cooling time, which are critical for an efficient casting process.

EXAMPLE OF DESIGN FLOW CHART:-

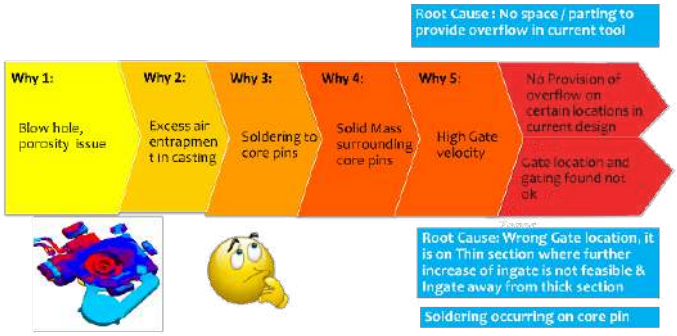


Simulation tools are also employed for Serial production Parts to reduce:-

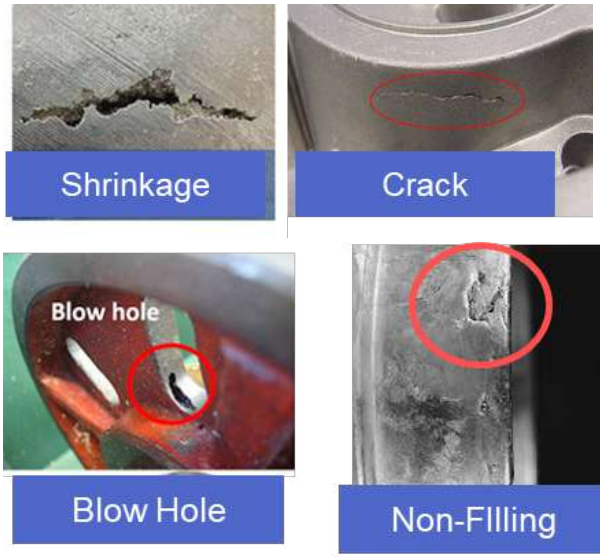
1. Rejection %
2. Improve Yield
3. Increase productivities
4. Optimize process parameters.

Certainly, utilizing simulation techniques aids in identifying the root cause of problems in manufacturing processes,

EXAMPLE OF WHY-WHY TOOL TO FIND OUT ROOT CAUSE



4. IMAGES OF FOUNDRY DEFECTS :



The foundry industry encounters a variety of defects in castings, including shrinkage porosity, hot spots, non-filling, as well as misrun, cold shut, hot tear, and gas porosity. These defects stem from complex interactions during the casting process and require meticulous analysis.

Simulation software serves as a critical tool for defect identification and resolution during the design stage. By employing advanced algorithms and numerical methods, engineers can simulate the casting process, predict defect occurrences, and implement corrective measures proactively.

5. TYPES OF SIMULATION METHOD:

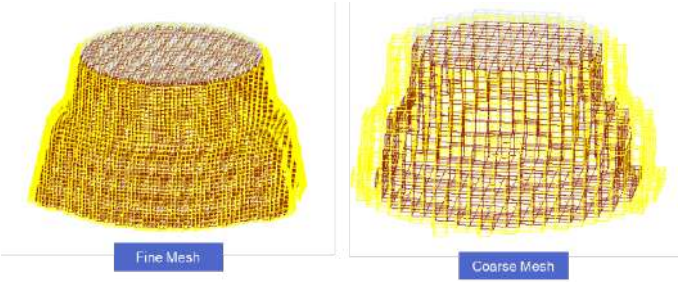
The finite difference method (FDM), the finite volume method (FVM), and the finite element method (FEM) are all three well-studied methods for building these simulations.

Absolutely, mesh size plays a crucial role in the accuracy and efficiency of casting simulation results.

Here's how mesh size impacts the simulation process:

Indeed, fine meshing is generally preferred over coarse meshing for casting simulation due to its ability to capture intricate details and complex geometries more accurately. However, the choice between fine and coarse meshing depends on various factors, including casting size, thickness, and the desired level of accuracy.

EXAMPLE OF MESH IMAGES:



6. DEFECT PREDICTION:

Absolutely, the capability of casting simulation software to accurately predict defects is paramount in ensuring high-quality castings.

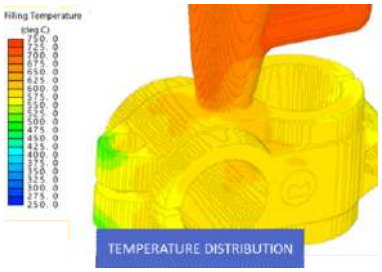
Accurate prediction of defects in casting simulation relies on the quality of input data,

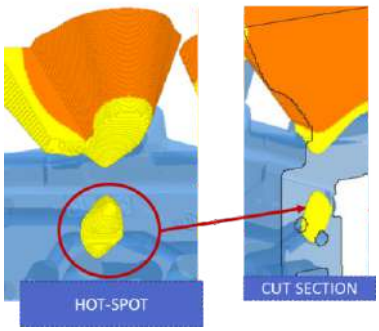
consideration of cooling conditions and ambient parameters, utilization of cyclic simulation techniques for external cooling systems, and ensuring the accuracy of material properties,

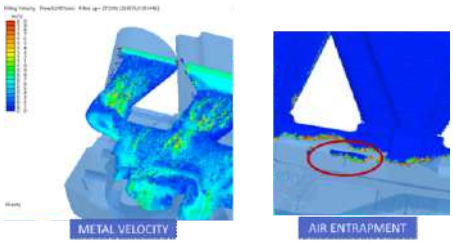
meshing, and boundary conditions.

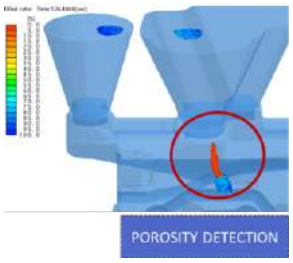
By meticulously addressing these factors, engineers can leverage casting simulation software to optimize casting processes, minimize defects, and enhance casting quality effectively..

EXAMPLE OF SIMULATION IMAGES:









Based on the defect analysis conducted in earlier simulations, precise actions can be undertaken to rectify issues pertaining to process, methodology, parameters, or design in subsequent simulation iterations.

Upon achieving desired results, the same design methodologies and parameters can be employed for manufacturing the tool and conducting casting trials.

It is imperative to consistently compare simulation outcomes with actual casting runs to evaluate the accuracy of the simulations and establish a comprehensive database of findings.

7. NEW TECHNOLOGY:

Simulation software continually evolves to meet customer demands and align with advancements in casting machine technologies.

In updated versions, software manufacturers integrate new features to enhance the capabilities of casting simulation, including:

- Integration of squeeze pin application functionality.
- Regular updates to the database to accommodate new requirements and materials.
- Optimization to reduce storage space requirements while maintaining performance.
- Introduction of porosity comparison tools to correlate simulation results with actual X-ray reports.

These advancements enable users to conduct simulations that incorporate the latest market technologies, thereby enhancing their ability to analyse and optimize casting processes effectively.

8. CHALLENGES:

Simulation software serves as a potent instrument for analysing the intricacies of casting manufacturing processes. Despite its numerous benefits, it also comes with inherent challenges and limitations.

Primarily, the accuracy of simulation results hinges on the quality and precision of the data and user inputs. However, obtaining precise data can often pose a significant challenge.

Many different factors in the environment can lead to defects in castings. It's hard to include all of these factors in the database we use for simulations.

Thus, the accuracy of simulation outcomes heavily relies on the precise values assigned to these coatings and materials in the input database. Ensuring accurate input parameters is paramount to obtaining reliable simulation results.

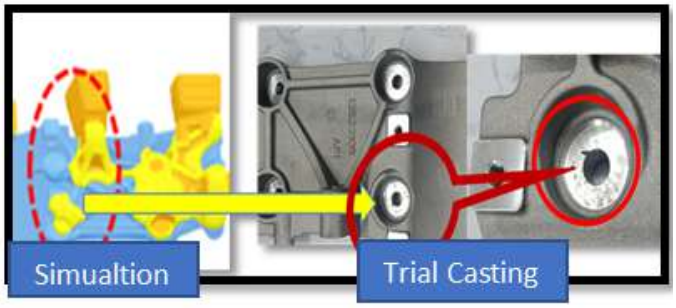
EXAMPLE:

	tmospher	HSG	3.casting	Gate	Coating	gate
Material Name	Air	SKD61	AC4B(AA...	AC4B(AA...	SKD61	AC4B(AA...
Slip Condition	0	0	-	-	0	-
Density(g/cm^3)	0.001	7.8	2.77	2.77	7.8	2.77
Thermal Conductivity(cal/cm s deg)	6e-5	0.102	0.25	0.25	0.102	0.25
Specific Heat(cal/g deg)	0.24	0.1	0.23	0.23	0.1	0.23
Initial Temperature(deg C)	40	280	730	730	280	730
Liquidus Temperature(deg C)	-	-	585	585	-	585
Solidus Temperature(deg C)	-	-	516	516	-	516
Latent Heat(cal/g)	-	-	93	93	-	93
Surface Tension(dyn/cm)	-	-	900	900	-	900
Contact Angle(deg)	-	-	95	95	-	95

9. CASE STUDY:

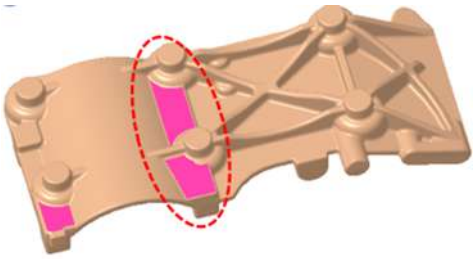
SHRINKAGE POROSITY IN CASTING:-

The following image illustrates the location of the shrinkage porosity observed in the T0 trial casting, which corresponds to the same location depicted in the simulation results.



In the next trial, a feeder rib was incorporated into the casting after obtaining customer approval to ensure connectivity through the feeder.

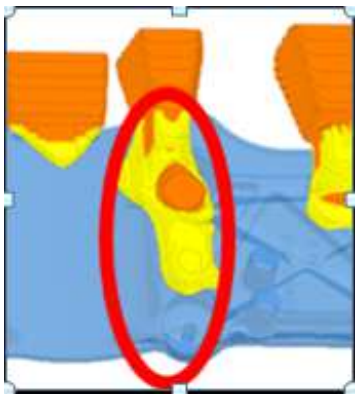
PROPOSAL IMAGE OF ADDITION OF FEEDER RIB (PINK COLOUR)



After the addition of the feeder rib, the elimination of the porosity issue was observed in both the simulation results and the subsequent casting trial run.

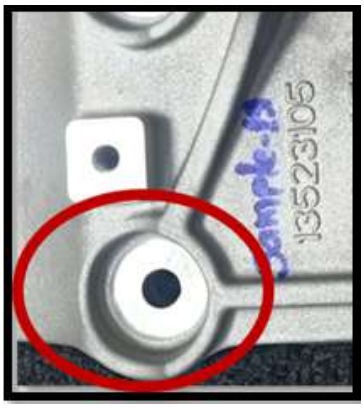
AFTER SIMUALTION:-

Found better connectivity after adding Feeder Rib



AFTER TRIAL CASTING IMAGE:-

No Shrinkage Porosity observed in Casting



10. CONCLUSION:-

Simulation analysis software, leveraging virtual processes, can effectively replace numerous trials within the casting process, thus saving both time and money.

With accurate simulation results, potential foundry defects like shrinkage porosity, blow holes, velocity issues, and excess temperatures can be predicted during the design stage. This allows for appropriate actions to be taken in the design phase to mitigate such defects during casting runs.

This approach necessitates expertise in input parameters, which are typically not readily accessible to product designers. However, optimal results can be achieved through collaborative involvement of foundry members and tooling engineers during the design phase to attain desired outcomes.

Adopting the correct approach to simulation activities during tooling design can significantly reduce the number of trials during development and eliminate scrap during casting production.

The virtual foundry would be managed by a team of qualified casting engineers to provide the necessary guidance and technical expertise.

KEYWORDS:

- Casting Simulation
- Yield Improvement
- Rejection Control
- First Time Right
- Reduce Lead Time
- Process Optimisation
- Increase Productivity
- Reduce Re Work Cost

My Career in Aluminium Die Casting Industry

Sangita Baburao Sagaokar
Founder - Pranit Engineering Works,
Chairperson - Prantech Components Pvt Ltd

Mrs. Sangita Baburao Sagaokar, a woman entrepreneur has successfully expanded her business in the die casting industry. As the founder of Pranit Engineering Works and Chairman of Prantech Components Pvt Ltd, both units are located in Chikhali, Pune.

Mrs. Sangita Baburao Sagaokar is born in an ordinary family in the village of Maan in Kolhapur district. She is educated till class 5th in Mumbai and Kolhapur.

Also, due to financial situation at home, further education could not be taken. At the age of sixteen, she married Mr. Baburao Dattatray Sagaokar. While her husband was working in Mumbai, she got an opportunity in an aluminum die casting company. for Livelihood and Sustenance Mr. and Mrs. Sagaokar had to travel around Mumbai, Nashik, Aurangabad, Pune, etc. While in Mumbai Mrs. Sangita Baburao Sagaokar saw her husband working round the clock. she used to make light buttons, dressmaking, so that she could also contribute to the house.

In 1999 Shri Baburao Sagaokar was transferred from Mumbai to Pune. Even after coming to Pune, Shri Baburao Sagaokar used to travel from Pune to Aurangabad for work. At the same time when Sangita was staying in Pune, the family living next door had a rubber molding workshop.

Seeing that, Mrs. Sangita Sagaokar asked them if she could do some work from home, saying that she would do it, and she started rubber parts rework and assembly by sitting in the house. After finishing the house work every day, in the afternoon, she used to remove burr of rubber parts at home. Again Mrs. Sangita migrated to Aurangabad from Pune in 2001. After learning sewing there, she made clothes and contributed financially to the family. But at the same time Doctors asked Mrs. Sangita to take rest due to health issues But in 2005 Sagaokar family again migrated to Pune. At that time her husband was working as a works manager in a company and he encouraged Mrs. Sangita to learn the die casting process so that she could ignore the illness and gain mental strength.

In this time period she got the major guidance and blessings of her Holiness Shri Vasudev Maharaj Garuda, Induri. Mrs. Sangita Baburao Sagaokar experienced and learned the working of a die casting process at her husband's working company.

In the year 2005 Pranit Engineering Works was established in a small shop. She used to travel 25 to 30 kilometers by bus every day from Chinchwad to Chakan, after completion of all housework and by taking care of the children. From 2005 to 2007, she started working with fettling process. In this work she got the help of her brother Suresh Shyamrao Khopade to manage the daily work. Gradually started the work of shot blasting process. In the year 2007, she dared to purchase the first die casting machine. In this she took her company a step further and established an independent name for the company and herself in the market. Later Mrs. Sangita Baburao Sagaokar started handling all the activities of Pranit Engineering Works despite her low education.

In the year 2007, Mrs. Sangita's husband resigned from the company where he was the CEO and he started handling the marketing work for Mrs. Sangita at Pranit engineering works. Mrs. Sangita Sagaokar herself learned to operate the die casting machine, did the fettling, drilling, tapping, shot blasting of the die cast components herself and started training to the workers at her company. Gradually increasing the work of the company, in 2011, after purchasing a place for the company at Chikhali, Pranit Engineering Works shifted its work to its own premises Mrs. Sangita Sagaokar company started making all kinds of components required for automotive, defense, industrial, home appliances. provides various shapes of Aluminium & Zinc Die Cast Components required to customers. Due to her persistence in work and with the support of her husband, brother, children, she established her second company in 2019, Prantech Components Private Limited.

Mrs. Sangita Sagaokar has created employment for 100 people in the company started with 5 workers. 60% women are working in it and women operators are also working on the die casting machines. Now

Mrs. Sangita Sagaokar company is manufacturing parts for the Indian market as well as exports them.
In all these journeys, along with running the company, she took care of her own family and gave high quality education to her two children and also employed them in her company. And also working in social activities, in which she has adopted orphan children and taken responsibility for their education.

Awards -

1. Zero Defect Supplier Award
2. National Development Ratna Award
3. Shahuwadi-Panhala Ratna Award
4. Krantijyoti Savitribai Phule Award

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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.
- 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

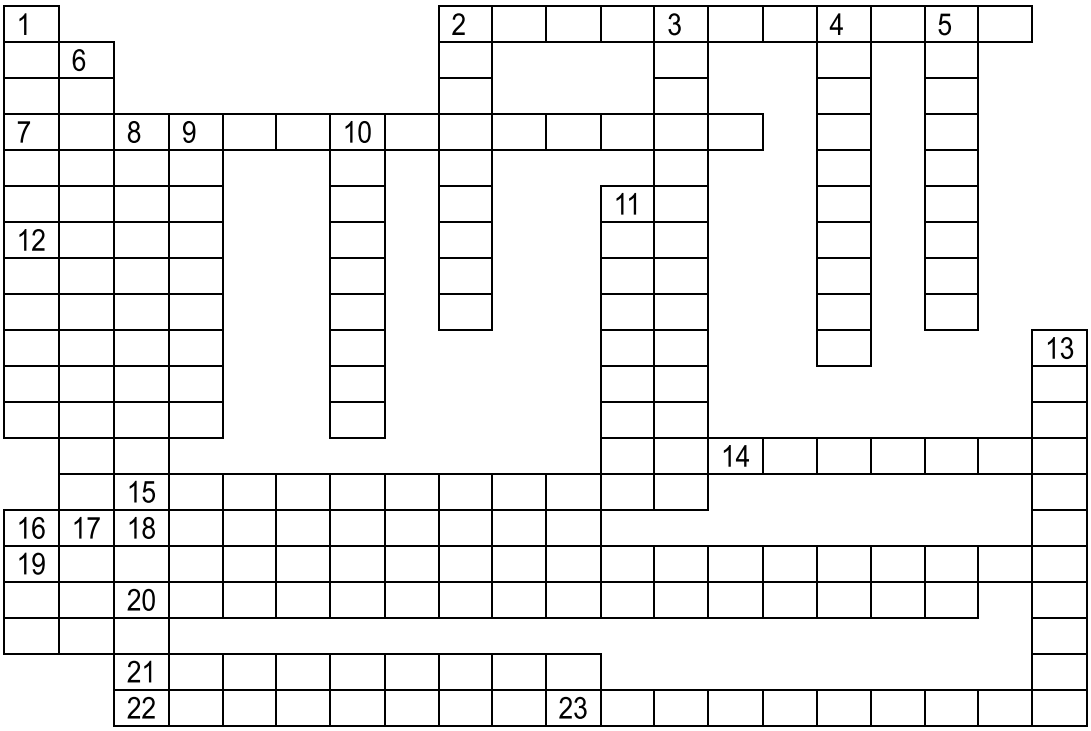
AGVs

CNC Robot

Pouring Robot

GDCTECH CROSSWORD #2
THE CUE: HPDC

Compiled by: Pramod Gajare Consultant (pramodgajare2013@gmail.com)



Clues Along:

2) During regular production run this never remains cold.
7) Period of time required to fill the cavity with metal.
14) This pushes the metal into the die,
15) The UHP grade nitrogen gas is normally not used in this.
18) This introduces anti-adhesion agents on the die surfaces.
19) In this process the metal injection mechanism is submerged in molten metal.
20) A programmed change in speed with time of the injection ram.
21) A sprout connecting a metal pot with a nozzle in the die.
22) These contain a very large number of oxides.
23) Through this hardened tube molten metal is fed into the die.

Clues Across:

1) A specific amount of metal forms this during each cycle of operation.
2) This allows the air from cavity to vent out but prevents the metal to escape by quickly solidifying it.
3) Product of shot projected area and casting pressure applied.
4) This is mounted to the toggle and clamp side of the die casting machine.
5) This apparatus helps to reduce human efforts for taking away a shot from the die.
6) It cools the hydraulic oil.
8) Air and gases are sucked out from the die cavities and runner during this process.
9) The act of forcing molten metal into a die.
10) Normally this die half does not contain ejector pins.
11) This indicates the percentage of air that will be introduced in the die along with the metal.
12) This is too flexible to tie a knot.
13) Through this molten metal is ladled into the die casting machine.
16) Part of die casting cycle in which molten metal is forced into the die. 17) Through this the molten metal enters injection cylinder of a hot chamber die casting machine

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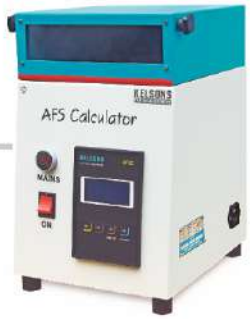

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