

Dedicated to Diecasting Industry



# ALUCAST®

Official Journal of Aluminium Casters' Association

Issue 158 - February 2026

## USE OF COMPOSITE MATERIAL IN DIE CASTING

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**N. Ganeshan**  
Editor

Dear Readers,

The die casting industry is a vital part of modern manufacturing, supplying high-precision metal components for automotive, aerospace, electronics, and consumer goods industries. Die casting involves forcing molten metals such as Aluminium, Magnesium, or Zinc into a steel Mold under high pressure or low pressure or gravitational force. While

conventional materials like tool steels and standard alloys have long been used in die casting, increasing demands for improved performance, durability, and efficiency have led to the adoption of composite materials. Composite materials, formed by combining two or more distinct materials, offer enhanced mechanical, thermal, and chemical properties that make them highly suitable for die casting applications.

There are many advantages of using Composite Materials in Die Casting process. One of the primary advantages of composite materials is their high strength-to-weight ratio. Metal matrix composites, especially aluminium-based composites reinforced with ceramic particles like silicon carbide or alumina, provide excellent strength while remaining lightweight. This characteristic is particularly beneficial in die casting operations where reduced tool weight improves machine efficiency and handling. Composite materials also exhibit superior wear and abrasion resistance. During die casting, tools and components are exposed to continuous friction, erosion, and contact with molten metals. Reinforcing materials such as ceramics or carbides help resist wear, reducing surface damage and extending the operational life of dies, inserts, and plungers. Thermal stability is another key benefit. Die casting processes involve repeated heating and cooling cycles that can cause thermal fatigue and cracking in conventional materials. Composite materials possess enhanced resistance to thermal shock and high temperatures, reducing the likelihood of deformation and failure. This results in improved reliability and consistency during long production runs.

Another important advantage is the lower coefficient of thermal expansion of composite materials. Reduced thermal expansion helps maintain dimensional stability under fluctuating temperatures, ensuring better accuracy and surface finish of die-cast components. This is crucial for producing precision parts with tight tolerances. Composite materials also provide improved resistance to corrosion and oxidation. Exposure to molten metals and harsh operating environments can degrade traditional materials

over time. Composites, however, offer better chemical stability, reducing maintenance requirements and machine downtime. Although composite materials may involve higher initial costs, their extended service life and reduced maintenance lead to long-term cost efficiency. Longer tool life and improved productivity result in lower overall manufacturing costs.

There are many applications of Composite Materials in the Die Casting Industry. Composite materials are widely used in die inserts and cores, particularly in high-temperature and high-wear regions. Metal matrix composite inserts improve thermal conductivity and resist erosion, enhancing die performance and lifespan. Shot sleeves and plungers are critical components that are subjected to intense thermal and mechanical stresses. Composite materials help reduce soldering and erosion caused by molten aluminium or magnesium, ensuring smoother operation and longer service life.

Ejector pins, slides, and other moving components benefit from the wear resistance and strength of composite materials. Their use minimizes breakage, sticking, and frequent replacements, improving overall machine reliability. Hybrid dies represent another important application. In this approach, composite materials are selectively used in critical areas while traditional tool steel is retained elsewhere. This combination optimizes performance while controlling costs.

Composite materials are also used in the production of lightweight die-cast components. Aluminium-based composites are commonly employed in automotive and aerospace parts such as engine components, brake systems, pistons, and transmission housings, where strength, wear resistance, and reduced weight are essential. In addition, composite materials play a significant role in thermal management applications. Die-cast composite heat sinks and electronic housings provide excellent heat dissipation and dimensional stability, making them ideal for modern electronic devices.

To conclude, use of composite materials in the die casting industry has brought significant improvements in tool performance, product quality, and manufacturing efficiency. Their superior strength, wear resistance, thermal stability, and corrosion resistance address many limitations of conventional materials. As industrial requirements continue to evolve, composite materials are expected to play an increasingly important role in advancing die casting technology and supporting high-performance manufacturing.

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# Use of Composite Materials in Die Casting

G Praburam | Alubee Die Casters Pvt. Ltd.

*“Composite materials do not replace die casting; they expand its possibilities...when applied with clarity, discipline, and purpose.”*

## ABSTRACT

Composite materials are gaining attention within the die casting industry as a means to address increasing demands for lightweighting, enhanced stiffness, wear resistance, thermal management, and dimensional stability...particularly in electric mobility, power electronics, and high-duty applications. While integrating composites directly into high-pressure die casting (HPDC) presents technical challenges, several practical and industrially viable pathways already exist. These include metal matrix composites (MMCs) for selective applications, hybrid castings using inserts and reinforcements, particle-enhanced alloys for wear and thermal control, and localized surface composite solutions. This article outlines composite material fundamentals, identifies realistic application opportunities in die casting, discusses key challenges, proposes practical remedies, and examines how hybrid architectures, MSME preparedness, and data-driven process control will shape the future of composite-enabled die casting.

## INTRODUCTION

Die casting remains a cornerstone of aluminium component manufacturing due to its high productivity, near-net shape capability, dimensional accuracy, and excellent surface finish. However, evolving industry requirements...such as aggressive weight reduction, higher thermal loads, increased durability, and tighter dimensional control...are pushing conventional aluminium alloys toward their functional limits.

Composite materials offer a pathway to overcome these limitations...not by replacing die casting alloys entirely, but by selectively enhancing material performance where required. Within the die casting ecosystem, this typically takes the form of metal matrix composites, hybrid castings with inserts, and locally reinforced or coated functional zones. The underlying objective is clear: retain the efficiency of die casting while enabling higher functional performance.

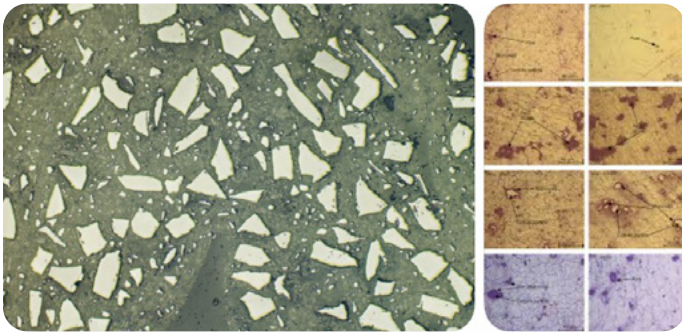


Modern die casting shop

## WHAT IS A COMPOSITE MATERIAL?

A composite material combines two or more distinct constituents to achieve properties not attainable by the individual materials alone. In the context of die casting, a composite system consists of:

- **Matrix** : the base metal, typically aluminium or magnesium alloy
- **Reinforcement**: ceramic particles, fibres, whiskers, preforms, or metallic inserts
- **Interface**: the bonding region between matrix and reinforcement, which governs real-life performance



Metal matrix composite (MMC)

## COMPOSITE FORMS RELEVANT TO DIE CASTING

### Metal Matrix Composites (MMCs)

Aluminium reinforced with ceramics such as SiC, Al<sub>2</sub>O<sub>3</sub>, or B<sub>4</sub>C to improve wear resistance, stiffness, and thermal behavior

- **Hybrid / Insert-Reinforced Castings**: steel, copper, or aluminium inserts integrated during casting for load-bearing, thermal, or functional features
- **Functionally Tailored Reinforcement**: reinforcement applied only in critical zones to balance cost and performance

## APPLICATIONS IN DIE CASTING

### 1. Wear-Resistant Functional Zones

<b>Applications</b>	Pump housings, valve bodies, bearing seats, actuator components
<b>Approach</b>	Particle-reinforced mmc zones or Surface composite layers
<b>Benefits</b>	Improved wear resistance, longer Service life, reduced scoring

### 2. Thermal Management Components

<b>Applications</b>	Inverter housings, motor controller heat sinks, LED housings
<b>Approach</b>	Copper or aluminium thermal inserts, MMC-based thermal tuning

<b>Benefits</b>	Reduced hot spots, improved thermal stability, enhanced electronics reliability
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Die cast housing for EV/ power electronics

### 3. Lightweight Stiff Structures with Improved NVH

<b>Applications</b>	EV brackets, cross-members, vibration-sensitive housings
<b>Approach</b>	Localized reinforcement paths or insert-supported ribs
<b>Benefits</b>	Higher stiffness-to-weight ratio, improved NVH, thickness reduction

### 4. Threaded and Load-Bearing Features

<b>Applications</b>	Mounting interfaces, structural fastening points
<b>Approach</b>	Steel inserts, bimetallic reinforcement rings
<b>Benefits</b>	Stronger threads, improved fatigue resistance, reduced field failures

### 5. Dimensional Stability Applications

<b>Applications</b>	Precision housings, sensor mounts, electronic enclosures
<b>Approach</b>	particle reinforcement to control thermal expansion
<b>Benefits</b>	Reduced distortion during thermal cycling

## CHALLENGES IN COMPOSITE DIE CASTING

Despite clear advantages, composite adoption in HPDC faces several challenges:

- Limited wettability between molten aluminium and ceramic reinforcements
- Increased melt viscosity affecting flow and fillability
- Accelerated tooling wear due to abrasive reinforcements
- Higher sensitivity to porosity, oxides, and particle clustering

- Increased machining difficulty and tooling cost
- Higher material and qualification costs
- Greater complexity in quality assurance and validation

## REMEDIES AND PRACTICAL SOLUTIONS

### Material & Melt Management

- Use coated reinforcements or alloying strategies to improve wettability.
- Limit reinforcement fraction and adopt localized reinforcement
- Ensure controlled addition, effective stirring, and strict temperature discipline
- Strengthen degassing and filtration practices

### Process Optimization

- Prefer hybrid insert casting over full MMC implementation
- Redesign gating and runners to avoid particle segregation
- Maintain stable die thermal balance
- Use vacuum-assisted die casting to control porosity

### Tooling & Machining

- Apply hard coatings and wear-resistant inserts in critical die areas
- Use replaceable gate components
- Minimize machining through near-net design
- Use PCD tools or shift to surface composite solutions where appropriate

### Quality Assurance

- Monitor reinforcement distribution during PPAP
- Track critical process parameters such as vacuum level and shot profile
- Apply suitable NDT methods for critical applications
- Align validation testing with functional performance requirements

## MSMES' UNDERSTANDING AND PREPAREDNESS

MSMEs form the backbone of the Indian die casting industry, and their preparedness will largely determine the pace of composite adoption. The primary challenge is not intent, but clarity and capability building.

Prepared MSMEs recognize that composite adoption does not require full-scale transformation. Practical entry points include hybrid insert castings, localized reinforcement trials, and low-volume, high-value applications. Success depends more on process discipline than capital investment, supported by skill development, ecosystem collaboration, and early customer engagement.

A critical mindset shift...from material cost per kilogram to value delivered per function...will position MSMEs as solution partners rather than component suppliers.

## THE FUTURE OF COMPOSITES IN DIE CASTING

The future lies in hybrid architectures, functionally tailored reinforcement, and digitally controlled processes, rather than universal MMC usage. Growth areas include EV and power electronics castings, large integrated structures with local reinforcements, improved reinforcement engineering, and IoT-enabled process control to manage narrower operating windows.



Large casting with localized reinforcement

## CONCLUSION

Composite materials offer a strategic opportunity for the die casting industry to meet rising performance expectations without compromising productivity. Their success lies in targeted, application-driven deployment...through hybrid castings, localized reinforcement, and disciplined process control.

MSME preparedness, supported by ecosystem collaboration and value-based evaluation, will be a decisive enabler of scalable adoption. As castings grow larger and functional demands increase, composite-enabled die casting is set to evolve from a specialized solution into a core industrial capability, driven as much by collective learning and alignment as by material innovation itself.

Happy Die Casting!



**G Praburam**  
Managing Director  
Alubee Die Casters Pvt. Ltd., Hosur

## ALUCAST® 2025

TECHNICAL CONFERENCE & TABLE TOP EXHIBITION  
HOTEL DOUBLE TREE BY HILTON, PUNE | 25<sup>th</sup> & 26<sup>th</sup> NOVEMBER 2025

### EVENT REPORT

#### ALUCAST 2025:

- ALUCAST 2025 attracts a strong participation of Delegates, Exhibitors, and Visitors.
- Representatives from more than 150 companies across India and overseas gathered at the annual event dedicated to the Aluminium Die Casting Industry.

The Aluminium Casters' Association (ALUCAST)®, India successfully hosted its annual event – ALUCAST 2025 on the theme “**Effective Application of Modern Technology in Casting Processes**”, held on 25th & 26th November 2025 at Hotel DoubleTree by Hilton, Chinchwad, Pune.

The 2-day Technical Conference and Tabletop Exhibition, organized by ALUCAST®, witnessed enthusiastic participation from industry leaders, OEMs, suppliers, technologists, and academia.

During his inaugural address, Mr. Gosain emphasized the critical role of modern technology, automation, and data-driven systems in transforming die-casting operations, reinforcing how the event theme aligns with the industry’s pursuit of efficiency, precision, and global competitiveness.



The event was inaugurated by Mr. Vivek Gosain, Vice President – Manufacturing Engineering, Force Motors, Pune, in the presence of Mr. T. Parabrahman, Trustee, Mr. Bharat Agarwal, Trustee, Mr. Niranjnan Toraskar, Trustee & Hon. Treasurer, Mr. Natarjan Ganeshan, Trustee, Ms. Vidhi Daryanani, Secretary-General, ALUCAST, and several senior professionals from the die casting and allied sectors.

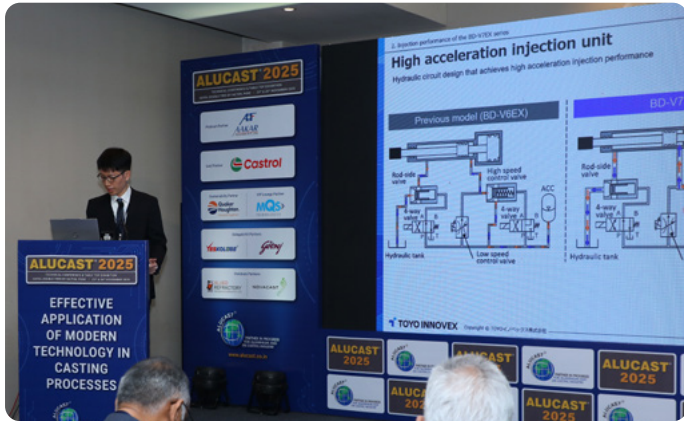
The focus of ALUCAST 2025 was to bring together industry leaders, OEMs, suppliers, and technology innovators in die casting, automation, and lightweight materials, offering exposure, networking, and thought-leadership opportunities to over 350+ industry professionals.



## TECHNICAL CONFERENCE

The Technical Conference featured a total of 21 sessions, comprising a mix of technical research papers and insightful product presentations delivered by die-casting experts, solution providers, and technology leaders.

**More than 125 delegates from the die-casting and allied sectors attended the sessions.**



A key highlight was the **“Startup Pitch Session – Innovate for Die Casting”**, where student innovation teams presented next-generation concepts. This platform enabled young innovators to connect with industry leaders, gain mentoring support, and showcase fresh ideas, while members benefited from early access to emerging technologies and future talent. The session celebrated innovation, entrepreneurship, and the vision of Start-up India.



## TABLETOP EXHIBITION

The Exhibition featured 14 Tabletop Exhibitors, including leading global aluminium casting manufacturers, equipment suppliers, tooling solution providers, and allied product companies. Exhibitors showcased their latest technologies, advanced tools, equipment, and consumables that support process improvement and capability enhancement in the casting industry.



ALUCAST 2025 saw participation from more than 125 companies, including leading brands such as Aakar Foundry Pvt. Ltd., Jaya Hind Industries Pvt. Ltd., Castrol India Ltd., Yuken India Ltd., Quaker Houghton, Vishwakarma Institute of Technology, Flow Science Software Pvt. Ltd., PCK Buderus India Special Steels Pvt. Ltd., among others.

## PUBLICATION RELEASES

During the inaugural, ALUCAST released the following publications:

- ALUCAST 2025 Technical Volume
- ALUCAST Technical Journal – December 2025 Special Issue
- Aluminium Casting Industry Directory – 11th Edition



**ALUCAST 2025** – the Annual Technical Conference & Tabletop Exhibition on “Effective Application of Modern Technology in Casting Processes” concluded successfully on 26th November 2025, marking yet another significant milestone in knowledge sharing, collaboration, and industry advancement.

## ALUCAST AT EUROGUSS 2026

### ALUCAST Pavilion and Delegation to EUROGUSS 2026

ALUCAST led a Business Delegation of exhibitors and visitors to EUROGUSS 2026 - one of the world’s leading international trade fairs dedicated to die casting, foundry technology, processes and applications at Nuremberg, Germany from 13th to 15th January 2026 in collaboration with travel partner Arrange my Tours Pvt. Ltd.



### Visitors’ Delegation

An enthusiastic and knowledgeable group of 26 professionals participated with ALUCAST as visitors. The group visited exhibitor booths and product demonstrations and participated in B2B meetings for knowledge sharing and exposure to global best practices. Not only did the visitors have great knowledge enhancing and business possibilities, they also got networking opportunities to develop valuable business connects. A short city tour was also organised for leisure time.

The highlight of the delegation was visit to BMW Foundry at Landshut, Munich. The plant tour, personally headed by BMW plant head, Mr Thomas Thym, was organized by ALUCAST to gain first-hand exposure to advanced automotive manufacturing practices and to understand BMW’s approach to innovation, automation, digitalization and Industry 4.0 solutions towards quality and sustainability.

The Delegation included professionals from Abhinitee India, Marvel Technology & Tools Pvt. Ltd., TechSense Engineering Services Pvt.Ltd., Chamundi Diecast (P) Ltd, Febtech Industries, MK Tron Auto Parts Pvt. Ltd., Quaker Chemical India Pvt. Ltd., Jaya Hind Industries Private Limited. The positive testimonials received from the visitors highlighted the overall success of the visit!

## ALUCAST PAVILION

At Euroguss 2026, ALUCAST participated with a dedicated Pavilion to showcase Indian die casting capabilities. The Pavilion provided a common platform for the co-exhibitor companies, enabling them to present their products, technologies, and services to a global audience. This collective presence strengthened visibility, encouraged collaboration, and highlighted the growing capabilities of the Indian die casting industry at an international level.

Our esteemed co-exhibitors Bharat Fritz Werner Ltd. (BFW) , Maxop Engineering Company Pvt. Ltd., MK Tron Autoparts Pvt Ltd, Thaa Casting Limited and Rajshi Technologies India Private Limited. experienced great momentum, bustling energy and top quality networking at the 3-day Trade Fair.

The event kicked off with a warm reception hosted by Eike Scholl, Executive Director - NürnbergMesse GmbH, Mario Bethge, Global Sales Manager - EUROGUSS & Heike Slotta, Executive Director - NürnbergMesse GmbH.

The co-exhibitors also had the exclusive opportunity to have an encouraging interaction with ALUCAST President, Prasan Firodia, Managing Director - Jaya Hind Industries Ltd & Force Motors Ltd.





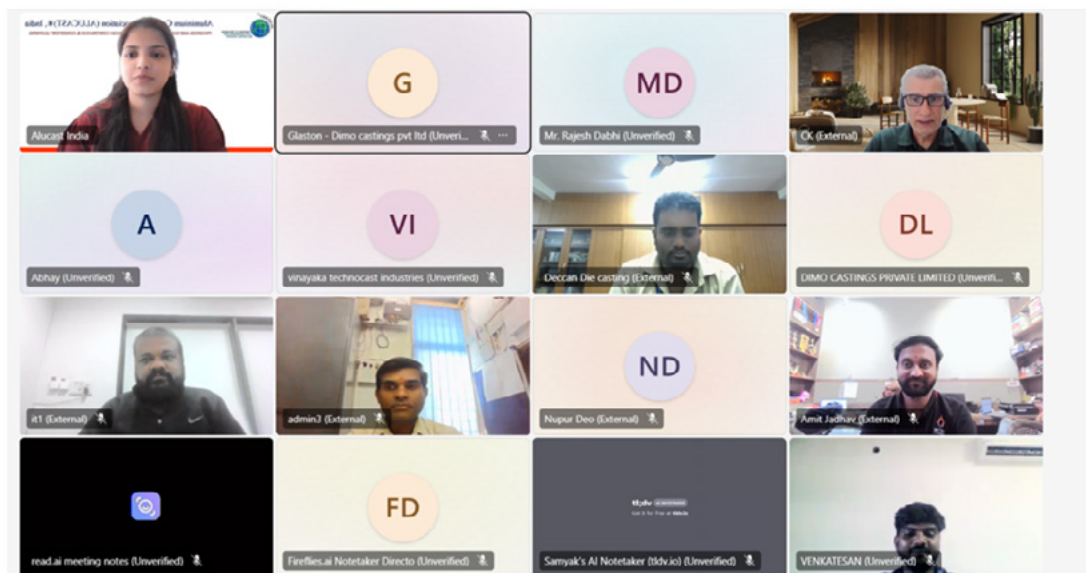
This year witnessed the highest number of Indian exhibitors at Euroguss (over 30 companies), out of which 15% chose to showcase their brand under ALUCAST Pavilion! Great innovations, productive meetings and valuable business connects - it was a great sum-up for the co-exhibitors. The visit also set the tone for the upcoming Mega Expo ALUCAST 2026 going to be held from 10<sup>th</sup> to 12<sup>th</sup> December 2026 in New Delhi in cooperation with NürnbergMesse India.

## ALUCAST WEBINARS HELD IN DEC 2025 - JAN 2026

<b>Title</b>	Digital Platform Systems and how they can Benefit Transparency on the Shop Floor
<b>Date</b>	Friday, 12 <sup>th</sup> December 2025
<b>Time</b>	03:00 PM to 04:30 PM IST
<b>Venue</b>	Online via MS-Teams
<b>Speaker</b>	Mr. Christian Kleeberg Founder & Managing Partner RGU ASIA PTE LTD

### Session Highlights:

- Challenges with current digital systems in foundries.
- Common reasons for implementation failures.
- Overuse of Excel, paper, and manual processes.
- Lack of integration leading to low transparency.
- Multiple sources of truth causing errors.
- Comparison of Excel/ERP vs. specialised FRP® systems
- Key factors for selecting the right digital platform.
- Practical tips for successful implementation.
- Importance of real-time data and system connectivity.
- Benefits of a unified digital system on the shop floor.

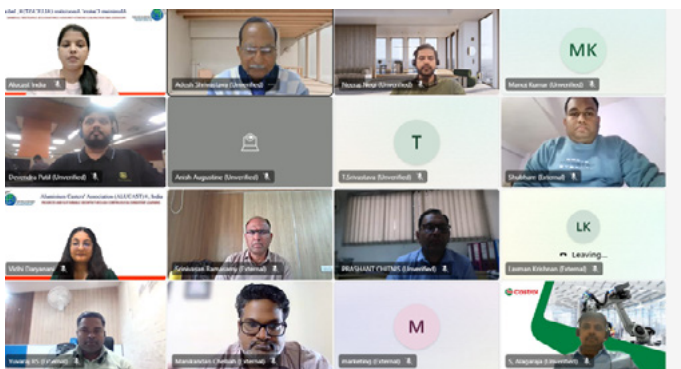
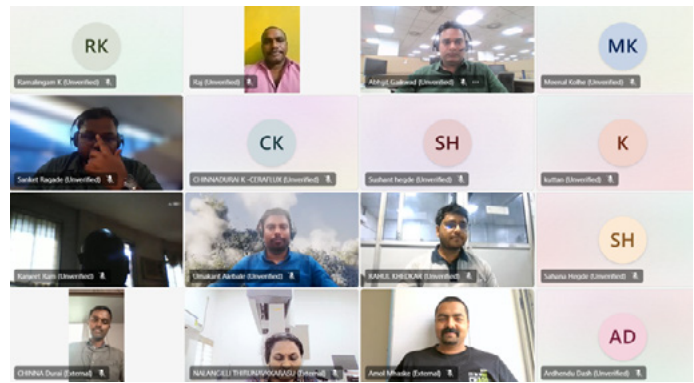


Title	Die Casting: From Fundamentals to Advanced Practices
Date	Wednesday, 28 <sup>th</sup> January 2026
Time	03:00 PM to 05:00 PM IST
Venue	Online via MS-Teams
Speaker	Mr. Adesh Shrivastava, Sr. Projects Technical Advisor – Aluminium Foundry

**Session Highlights:**

**Session 1: Introduction to Die Casting – Basics**

- Overview of die casting and HPDC process
- Purpose and fundamentals of HP die casting
- Types of die casting machines (hot & cold chamber)
- Basic process explanation with videos, sketches, and machine images
- Major HPDC machine parts and key functions
- Safety aspects in die casting operations
- Basic machine specifications and autonomous maintenance points
- Participant activity and introduction to advanced HPDC stage



**Session 2: Introduction to Latest Die Casting – Advanced Practices**

- Current needs of aluminium foundries and technology trends
- Role of die casting in EV, defence, and Atmanirbhar Bharat initiatives
- Latest HPDC machine specifications and industry trends
- Two-platen and three-platen machine developments
- Advanced technologies: servo hydraulics, injection systems, mold controls, and intelligent safety systems
- HPDC work cell concept and key peripheral equipment
- Summary of advanced die casting practices

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# Opportunities and Challenges of Composite materials in Aluminum Die Casting

Dr. Rajesh Chaudhari

Faculty in Mechanical Engineering Department | Vishwakarma Institute of Technology, Pune

## ABSTRACT

In the demanding landscape of high-pressure die casting (HPDC), material innovation is the primary lever for operational excellence. Die casting is a widely utilized manufacturing process that involves forcing molten metal into a mold under high pressure to create complex parts with excellent dimensional accuracy and surface finish. Traditionally, die casting has been associated with metals such as aluminum, zinc, and magnesium. Die casting tools are subjected to a severe thermo mechanical environment characterized by high-frequency thermal cycling and extreme asperity interactions under pressure. While traditional H13-type hot-work tool steels have long served as the industry benchmark, their limitations are increasingly exposed by modern productivity demands. To sustain high-volume output and dimensional precision, a strategic transition is required, moving from monolithic steels toward advanced Metal Matrix Composites (MMCs) and surface-engineered layers capable of resisting the specific degradation mechanisms of the casting process. The service life of a die is essentially a function of its surface integrity. Poor tribological properties manifest as high friction and adhesive galling, leading to the seizing of the cast part to the tool. Furthermore, "metal ion dissolution" represents a significant chemical failure mode where the tool surface reacts with the molten aluminum a process known as soldering causing localized erosion and material loss. This review evaluates Titanium Carbide (TiC) MMCs, atmospheric plasma-sprayed (APS) ceramic coatings, and double-glow plasma surface alloying as high-performance solutions. Composite materials can be designed to possess the desired properties of strength, toughness, and lightweight characteristics, while maintaining the benefits of conventional die-cast metals. This article explores the various applications and advantages of using composite materials in die casting.

**Keywords:** Metal matrix composites(MMC); Die casting; Mould materials; Dies and Tooling, Surface coating

## 1. INTRODUCTION OF COMPOSITE MATERIALS

Composite materials are made by combining two or more materials—typically one material that acts as a matrix and another material that acts as reinforcement. The matrix is usually a polymer, metal, or ceramic, and the reinforcement is often a fiber or particulate material. The aim is to leverage the unique properties of each component to enhance the overall performance of the material. Composite materials are classified as

- Metal matrix composites (MMCs) combine metals with reinforcing elements like ceramics or carbon fibers to improve strength, wear resistance, and thermal stability.
- Polymer matrix composites (PMCs), which combine polymers with fiber reinforcements like glass or carbon fibers, offer benefits in terms of reduced weight and increased impact resistance.
- Ceramic Matrix composites They are designed to overcome the inherent brittleness of monolithic ceramics. CMCs exhibit high strength and toughness even at elevated temperatures.

They have excellent resistance to wear, corrosion, and oxidation. These materials maintain mechanical properties under extreme thermal conditions. Common matrices include alumina, silicon carbide, and silicon nitride. Reinforcements are often SiC or carbon fibers. CMCs have low density compared to metals.

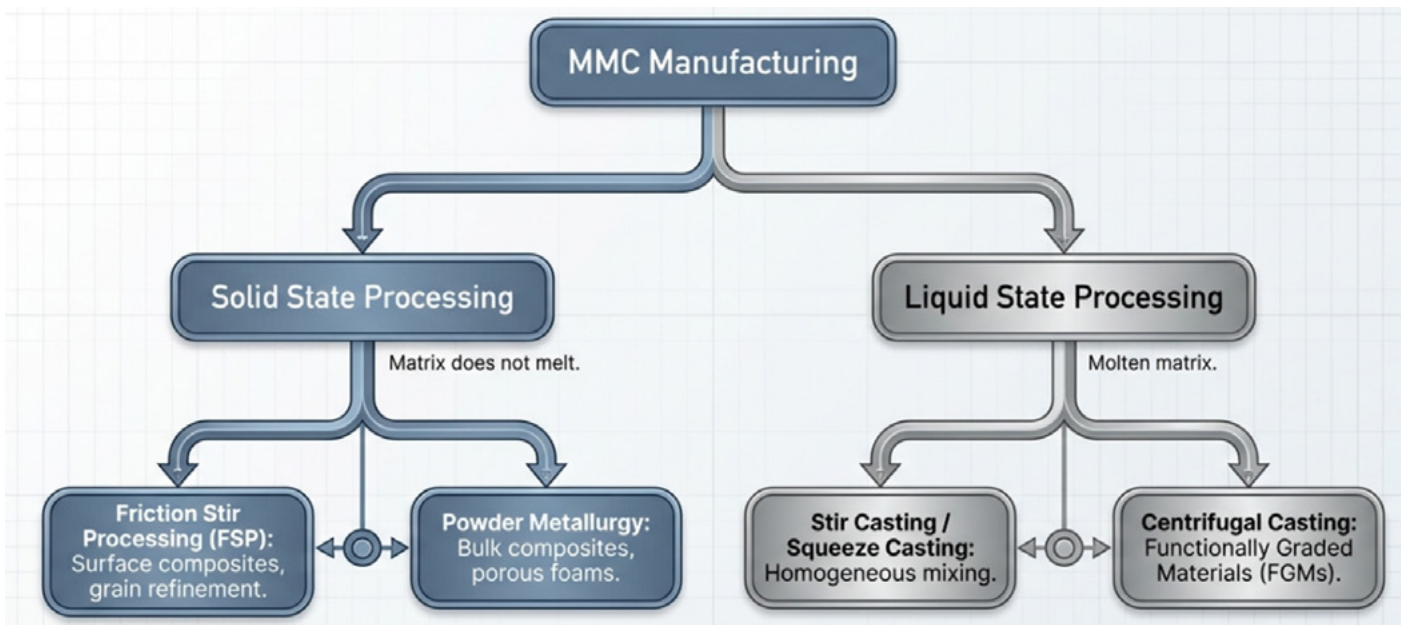


Fig.1 Classification of Metal matrix processing techniques

## 2. ADVANTAGES OF COMPOSITE MATERIALS IN DIE CASTING

The integration of composite materials in die casting presents several advantages, including:

### A) Improved Mechanical Properties

Composite materials often provide enhanced mechanical properties such as increased strength, stiffness, and wear resistance compared to conventional materials. For instance, metal matrix composites can offer higher tensile strength, better fatigue resistance, and improved thermal conductivity, which are crucial for applications where the cast parts are subjected to high stress and temperatures.

### B) Light weighting

One of the major advantages of composite materials is their ability to reduce weight while maintaining or improving mechanical strength. Light weighting is particularly important in industries such as automotive, aerospace, and electronics, where weight reduction can lead to improved fuel efficiency, reduced emissions, and better overall performance. Composites with carbon fiber reinforcement, for example, are incredibly light and strong, making them ideal for high-performance die-cast components.

### C) Enhanced Thermal and Corrosion Resistance

Composite materials can be engineered to have superior thermal stability, resistance to corrosion, and resistance to wear. Metal matrix composites (MMCs) like aluminum or magnesium reinforced with ceramic fibers or particles offer excellent resistance to thermal degradation and corrosion, making them ideal for automotive engine components, heat exchangers, and marine applications.

### D) Customization of Properties

Composite materials offer versatility in design. By adjusting the matrix material or the type and quantity of reinforcements, manufacturers can tailor the properties of the composite to meet specific requirements for strength, stiffness, thermal conductivity, or resistance to specific environmental factors.

## 3. APPLICATIONS OF COMPOSITE MATERIALS MANUFACTURED BY DIE CASTING PROCESS

### A) Automotive Industry

In the automotive sector, the demand for lightweight and high-strength materials is increasing, especially for parts that need to withstand high mechanical stresses and temperatures. Composite materials are being used to produce engine components, transmission parts, structural frames, and exterior panels. For example, metal matrix composites (MMCs) can be used in engine blocks or pistons to reduce weight and improve thermal performance. These composites also help in reducing fuel consumption and increasing vehicle efficiency, contributing to more sustainable automotive designs.

### B) Aerospace Industry

In aerospace manufacturing, the need for lightweight, durable, and high-performance materials is critical. Composite materials like carbon fiber-reinforced polymers and ceramic matrix composites are finding increasing use in die-cast components such as turbine blades, brackets, and housings. The high strength-to-weight ratio of these materials makes them ideal for reducing the weight of aircraft and spacecraft components without compromising performance. Metal matrix composites are particularly valuable in turbine engines, where components need to withstand extreme temperatures and mechanical loads.

### C) Electronics and Consumer Goods

Die-cast composite materials are also gaining traction in the electronics industry, where lightweight, durable enclosures and housings are required. Composite materials with good electrical and thermal conductivity properties are used in die casting to create heat sinks, cooling components, and protective casings for electronic devices. The ability to achieve intricate designs while maintaining superior strength and thermal conductivity makes composites a promising solution for modern electronic products.

### D) Marine and Off-Shore Applications

In the marine industry, parts exposed to harsh environments, such as saltwater, need to resist corrosion and wear. Composites with enhanced corrosion resistance are becoming essential for the production of offshore and underwater components. Magnesium-based composites, for instance, can be used to manufacture lightweight, high-strength parts that withstand the corrosive effects of seawater, providing longer-lasting and more reliable components for maritime applications.

## 4. COMPOSITE MATERIALS FOR DIE CASTING MACHINES

### 4.1. Composite Components for Die Casting Machines

Die casting machines typically include various parts like the injection system, the clamping system, and the cooling system. Composite materials can be used in certain machine components to reduce weight, enhance thermal conductivity, and improve durability.

**Injection Components:** Parts of the injection system, such as nozzles or plunger tips, can be made from metal matrix composites (MMCs) reinforced with ceramic or carbide particles. These composites offer superior wear resistance, enabling the machine to withstand the harsh conditions associated with molten metal injection.

**Clamping Components:** The clamping unit, which is responsible for holding the mold in place under high pressure, can be made with composite materials to improve strength and reduce weight. For example, carbon fiber-reinforced polymer (CFRP) composites can be used to reduce the overall weight of the clamping unit, which can help improve machine performance and energy efficiency.

**Cooling Systems:** Cooling plates and channels within the die casting machine can be made from composite materials that offer better thermal conductivity. Metal matrix composites, such as aluminum or copper reinforced with high-conductivity particles, can ensure efficient cooling of the mold during the die casting process, leading to faster cycle times and improved part quality.

**Guides and Bearings:** Composite bearings and guides can be used in the die casting machine's moving parts to reduce friction, improve wear resistance, and extend the life of these components. Composites like reinforced thermosetting polymers can be used in these applications.

## 4.2. Benefits of Using Composites in Die Casting Machines

**Weight Reduction:** Carbon fiber and fiberglass composites help reduce the overall weight of machine components, improving machine performance and energy efficiency.

**Wear Resistance:** MMCs and other advanced composites are resistant to wear and tear, making them ideal for parts exposed to the high pressures and temperatures in the die casting process.

**Thermal Management:** Composites with high thermal conductivity can improve cooling rates and reduce thermal stresses in the die casting machine, which enhances efficiency and product quality.

## 5. COMPOSITE MATERIALS FOR DIE CASTING DIES (MOLDS)

The molds (or dies) used in die casting are subjected to extreme conditions, including high temperatures, pressures, and wear. Using composite materials in the mold construction can significantly extend the lifespan of the die, improve heat dissipation, and reduce production downtime.

### 5.1. Metal Matrix Composites (MMCs)

**Usage in Dies:** Metal matrix composites (such as aluminum or copper alloys reinforced with ceramics or carbide particles) are used to manufacture die casting dies due to their excellent wear resistance, thermal conductivity, and resistance to thermal cycling. These materials help to reduce mold wear, a major problem in high-volume production, and they enable faster cooling rates due to their superior heat dissipation properties.

**Examples:** Aluminum or copper MMCs reinforced with silicon carbide (SiC), graphite, or tungsten carbide can be used in high-wear areas such as the gating system or cavity surfaces. Fig.1 shows schematics of stirring setup for uniform distribution of reinforced particles in metal matrix. Stirring to be carried out before pouring of liquid metal into the mould to avoid agglomeration of reinforced particles in metal matrix.

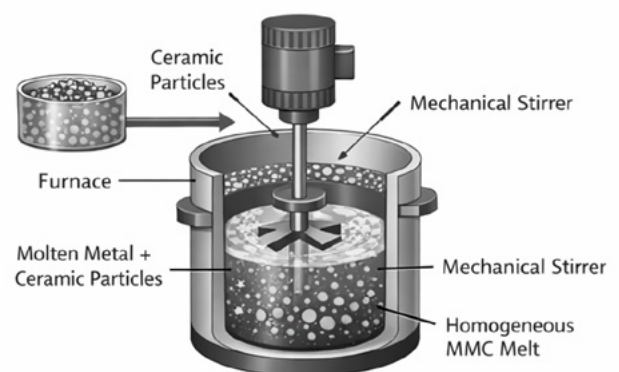


Fig.1 Stir casting method for manufacturing of metal matrix composites

## 5.2. Ceramic Matrix Composites (CMCs)

**Usage in Dies:** Ceramic matrix composites (CMCs), particularly those made with silicon carbide (SiC) or boron carbide (B4C), are used for making high-temperature, wear-resistant die components. They are ideal for applications where the die experiences extreme temperatures and wear. CMCs can be particularly useful in injection nozzles, plunger tips, and core inserts, where high thermal stability and resistance to erosion are required.

**Benefits:** CMCs offer excellent resistance to high-temperature oxidation and wear, making them suitable for parts exposed to molten metal at temperatures exceeding 600°C.

## 5.3. Graphite Reinforced Composites

**Usage in Dies:** Graphite is often used as a reinforcement in metal matrix composites, offering excellent thermal conductivity and wear resistance. Graphite-reinforced MMCs are particularly effective in die components that require rapid heat dissipation, such as cooling channels and gating systems.

**Benefits:** These composites can help reduce the cycle time of the die casting process by providing better thermal management, leading to higher productivity.

## 5.4. Carbon Fiber Reinforced Polymers (CFRPs)

**Usage in Dies:** Carbon fiber-reinforced polymers (CFRPs) are primarily used in auxiliary components of the die casting mold, such as cooling plates, frames, and covers. CFRPs are lightweight, have high tensile strength, and offer good thermal conductivity.

**Benefits:** They can help improve the efficiency of the cooling system, reduce thermal distortion, and extend the life of the die by reducing the likelihood of cracking due to thermal expansion.

## 5.5. Polymer Matrix Composites (PMCs)

**Usage in Dies:** Polymer matrix composites (PMCs), especially those reinforced with glass fibers, are used in applications that don't experience the extreme conditions of the die cavity but require lower-cost, lighter-weight components. These can be used for covers, enclosures, or smaller components within the mold that do not require the same heat and pressure resistance as the main die cavity.

**Benefits:** PMCs can reduce the overall weight of the mold, and glass-fiber-reinforced PMCs can offer an affordable solution for components with moderate strength and wear resistance needs.

## 6. SPECIFIC COMPOSITE APPLICATIONS IN DIE CASTING DIES

**Cooling Inserts:** Composite materials can be used for cooling inserts to improve the uniformity of the temperature distribution within the die. The enhanced thermal conductivity of these composites allows for quicker cooling times and less thermal distortion, which leads to improved part quality and faster production rates.

**Gating Systems:** Gating systems in die casting molds direct the flow of molten metal into the mold cavities. These systems experience high wear and thermal cycling. Using composite materials like MMCs in these areas can increase their resistance to wear and improve their longevity.

**Core Inserts:** Core inserts, which are used to create internal cavities within the cast part, can benefit from ceramic matrix composites (CMCs) due to their high-temperature stability and wear resistance. These inserts often come into contact with molten metal at high temperatures, so durability is critical.

**Sprue Bushings:** The sprue bushing, which is the passage through which molten metal enters the mold cavity, can be made from composites that combine metals like aluminum with reinforcing ceramics for enhanced wear resistance and thermal management.

**Die Inserts and Faceplates:** Inserts and faceplates are crucial to the die's structural integrity, and using advanced composite materials can improve their resistance to cracking under thermal shock and wear from molten metal. Fig.2 shows potential applications of Metal Matrix composite inserts in die casting dies and tooling to improve die life

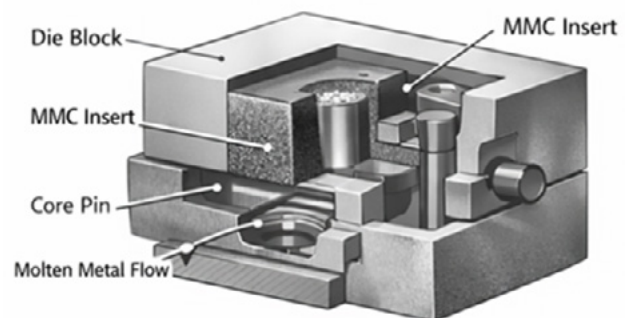


Fig. 2 Metal Matrix composite inserts applications in die casting dies

## 7. BENEFITS OF USING COMPOSITES IN DIE CASTING DIES AND MACHINES

**Improved Durability:** Composite materials, particularly MMCs and CMCs, are highly resistant to wear, corrosion, and thermal cycling, leading to a longer lifespan for both the die casting machine and molds.

**Better Thermal Management:** The high thermal conductivity of certain composites allows for better cooling, faster cycle times, and reduced thermal stresses in the mold, improving part quality and reducing distortion.

**Cost-Effectiveness:** Although composites can have a higher upfront cost, their durability and improved performance can lead to cost savings in the long run, including fewer replacements, reduced downtime, and lower maintenance costs.

**Reduced Weight:** The use of lightweight composites, especially in machine components, can improve energy efficiency and reduce wear on machine parts, resulting in enhanced operational efficiency.

**Table 1 Metal matrix composites and its impact on die life**

Technology Type	Key Reinforcement / Alloy	Primary Mechanical Advantage	Strategic Impact on Die Life
Bulk MMC Ti/Fe Matrix	TiC/TiB <sub>2</sub> /WC/SiC (10-20 Wt.%)	High rigidity (Matrix HRC 55); non-abrasive	Eliminates adhesive galling in guider pins
Surface Composite - Plasma Spray	A4Z (Al <sub>2</sub> O <sub>3</sub> -40% 8YSZ)	CTE Matching; Phase transition toughening	60x wear reduction; superior thermal barrier
Surface Composite - Double-Glow Plasma	Niobium (Nb)	Gradient metallurgical bond; low friction	Prevents soldering/erosion; zero delamination

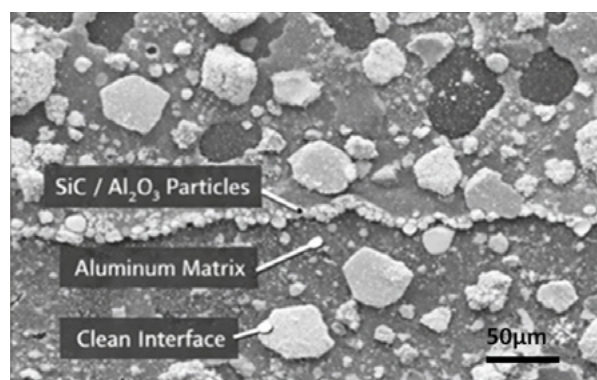
## 8. BULK AND SURFACE COMPOSITES FOR DIE CASTING APPLICATIONS

### 8.1 Ti Metal Matrix Composite:

Metal Matrix Composites reinforced with ceramic grains, particularly SiC, WC, ZrB<sub>2</sub>, TiC, TiB<sub>2</sub> and TiN represent a critical advancement for heavy industry tooling. The strategic advantage of TiC reinforcements lies in their "smooth shape" and inherent "alienation from metallic material. This chemical alienation prevents the formation of strong adhesive bonds with the steel counterpart, rendering the surface lubricious and non-abrasive. Unlike traditional hard metals that can cause severe scoring, the micro nano sized TiC, TiB<sub>2</sub> and TiN particles act as load-bearing asperities that minimize damage to the interface during sliding contact. While bulk MMCs provide structural durability, specialized ceramic coatings offer superior protection against the thermal and chemical erosion seen in the die cavity. Stir casting is recommended for uniform distribution of reinforcements in metal matrix before pouring in to mould or die, Fig 3 shows stir casting set up and corresponding Al composite die casting parts to be replaced with aluminum MMC for overall enhanced functional properties and lifespan of components. MMC inserts are used for dies and tooling elements. Fig. 4 shows microstructure of Al matrix hybrid composite with SiC and Al<sub>2</sub>O<sub>3</sub> reinforcements



**Fig 3 Stir casting process for manufacturing of composites by casting process**



**Fig 4 Microstructure of aluminum metal matrix composite processed by die casting process**

### 8.2. Plasma-Sprayed Al<sub>2</sub>O<sub>3</sub>-YSZ Composite Coatings for Thermal and Wear Protection:

Thick ceramic coatings are essential for shielding die components from the corrosive nature of molten aluminum and the stress of thermal expansion mismatches. While the principles of these coatings are often explored in biomedical contexts (Ti-6Al-4V substrates), their application to HPDC tooling is driven by their superior phase stability and splat cohesion.

- **Pure Al<sub>2</sub>O<sub>3</sub>:** Exhibits high hardness (9.43 GPa) but is susceptible to abrasive wear and splat dislodgement due to inherent brittleness.
- **8YSZ (8 mol% Yttria Stabilized Zirconia):** Offers better fracture toughness but is prone to delamination and complete removal under cyclical stress due to lower hardness (5.67 GPa) and high residual stresses.
- **A4Z (Al<sub>2</sub>O<sub>3</sub>-40 wt% 8YSZ):** The optimal composite coating. It provides superior cohesive strength between splats, preventing the lamellar stacking failure seen in pure zirconia.

To achieve even higher bond integrity, metallurgical surface alloying can be employed to eliminate the discrete interface between the coating and the substrate.

### 8.3 Double-Glow Plasma Surface Alloying: The Role of Niobium (Nb) Layers

The "Xu-Tec" or double-glow plasma surface alloying technology circumvents the delamination risks associated with traditional coatings by creating a gradient metallurgical bond. By diffusing Niobium (Nb) directly into the substrate at processing temperatures of 800–900°C and source voltages of 950-1000V, a compact and continuous alloyed layer (approx. 8 µm) is formed.

Technical and Industrial Advantages:

- **Mechanical Enhancement:** The process increases surface nano-hardness from 3.25 GPa to 5.25 GPa, while the friction coefficient is slashed from 0.57 to a mere 0.27.
- **Structural Integrity:** The resulting fine cellular structure and gradient distribution of Nb elements mitigate the production of wear debris.
- **Soldering Resistance:** Niobium's excellent chemical stability resists the metal ion dissolution (soldering) typically caused by molten aluminum. Furthermore, the vacuum-based process inherently avoids hydrogen embrittlement, ensuring long-term fatigue resistance.

Understanding these surface modifications allows for the development of predictive maintenance models based on wear thresholds. The integration of TiC MMCs and advanced plasma-surface engineering represents a paradigm shift in die casting. By moving toward materials with tailored CTEs and gradient metallurgical bonds, manufacturers can overcome the traditional limits of tool steel, ensuring higher precision and drastically reduced downtime in the production of aluminum components.

## 9. CHALLENGES IN INTEGRATING COMPOSITES INTO DIE CASTING

Despite the numerous advantages, there are challenges associated with integrating composite materials into the die casting process. These include:

**9.1 Complexity in Manufacturing:** The integration of composites into die casting may require more complex processes and specialized equipment, especially when dealing with high-performance composite materials like carbon fiber or ceramic-reinforced composites. Achieving the right balance between the matrix and reinforcement in terms of distribution and bonding is also crucial to ensure the desired properties.

**9.2 Cost Considerations:** Composite materials, particularly metal matrix composites and carbon fiber reinforcements, can be more expensive than traditional materials. The cost of raw materials and the advanced processing techniques required can make composite die casting more expensive, particularly in industries where cost is a critical factor. However, the long-term benefits, such as reduced maintenance costs and improved performance, can offset these initial higher costs.

**9.3 Compatibility with Die Casting Equipment:** Not all die-casting machines are compatible with composite materials, and some may require modifications to accommodate the specific characteristics of composites. For example, reinforcing fibers may cause wear on the die-casting molds, requiring more frequent maintenance or specialized coatings to improve mold longevity. Fig 5 shows Low pressure die casting process can be used with few modifications for stirring of molten metal for uniform distribution of reinforcements to manufacture aluminum composite parts.

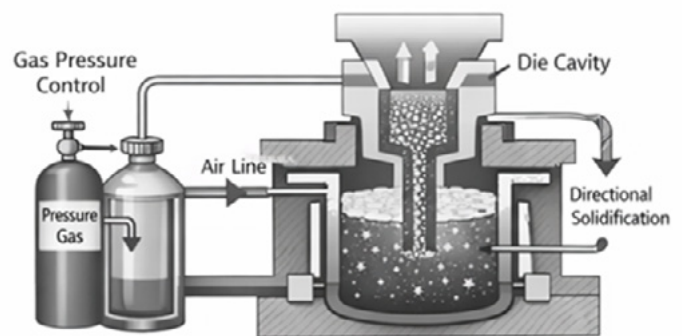


Fig 5 Low pressure die casting set up for aluminum metal matrix composite processing

## 10. FUTURE PROSPECTS

The use of composite materials in die casting is expected to grow, driven by advancements in material science, manufacturing technologies, and the increasing demand for lightweight and high-performance components in industries like automotive, aerospace, and electronics. As technology continues to evolve, the integration of composites in die casting will become more efficient, cost-effective, and widespread.

Researchers are focused on developing new composite formulations, such as hybrid composites, that combine the benefits of multiple types of reinforcements. Innovations

in additive manufacturing and 3D printing are also contributing to the development of new composite materials that can be integrated into die-casting processes, offering even greater design flexibility and performance enhancements.

## CONCLUSION

The integration of composite materials into die casting presents significant opportunities for improving the performance, strength, and lightweight characteristics of cast components. By leveraging the unique properties of composite materials, manufacturers can create parts that are not only stronger and more durable but also lighter and more resistant to extreme environments.

While challenges remain, the continued development of composite technologies in die casting is set to transform industries ranging from automotive to aerospace and electronics, driving innovation and sustainability in manufacturing. In die casting, both the die casting machines and the dies can benefit from the use of composite materials to enhance performance, reduce wear, and improve thermal management. These materials provide superior strength, wear resistance, and thermal conductivity, making them ideal for the demanding environment of die casting.

## REFERENCES

1. Bamberger, M., Huber, H., & Reiss, G. (2020). "Wear and Thermal Performance of Copper-Based MMCs in Die Casting Gating Systems." *Journal of Materials Processing Technology*, 284, 116792.
2. Choudhury, A., Ghosh, P., & Roy, P. (2016). "Application of Metal Matrix Composites in Die Casting Dies: A Review." *Materials Science and Engineering: A*, 655, 148–158.
3. Sang, P., Zhang, X., & Jiang, Y. (2022). "Advancements in Metal Matrix Composites for Die Casting Applications: A Comprehensive Review." *Composites Part B: Engineering*, 234, 109687.
4. Sharma, V., Saini, D., & Kumar, R. (2017). "Aluminum and Copper-Based Metal Matrix Composites for Die Casting Applications." *International Journal of Cast Metals Research*, 30(6), 316-325.
5. Tajuddin, M., Yusof, M., & Ismail, M. (2019). "Applications of MMCs in Die Casting: Enhancing Efficiency and Reducing Weight." *Materials and Manufacturing Processes*, 34(10), 1220-1230.
6. Wu, Y., Zhang, X., & Li, H. (2018). "Performance of Metal Matrix Composites in High Wear Environments for Die Casting Machines." *Journal of Manufacturing Science and Engineering*, 140(5), 051019.
7. Zhang, L., Huang, X., & Li, Y. (2021). "Improvement of Cooling Efficiency in Die Casting Using Graphite-Reinforced MMCs." *Heat and Mass Transfer*, 57(7), 1139–1151.
8. Kamandanu, I. and Pranoto, H., 2020. A review of fabrication method of casting metal matrix composite materials in liquid state. *International Journal of Advanced Technology in Mechanical and Materials Engineering*, 2(1), pp.1–10.
9. Surappa, M.K., 2003. Aluminium matrix composites: challenges and opportunities. *Sadhana*, 28(1–2), pp.319–334.
10. Ramesh, C.S., Safiulla, M. and Suresh, M., 2011. Wear behavior of Al 6061–SiC composites. *Materials & Design*, 32(8–9), pp.4354–4361.
11. Prasad, S.V. and Asthana, R., 2004. Aluminum metal–matrix composites for automotive applications. *Tribology Letters*, 17(3), pp.445–453.
12. Hashim, J., Looney, L. and Hashmi, M.S.J., 1999. Metal matrix composites: production by the stir casting method. *Journal of Materials Processing Technology*, 92–93, pp.1–7.
13. Rohatgi, P.K., 1991. Cast aluminum–matrix composites for automotive applications. *JOM*, 43(4), pp.10–15.



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# Reflections from the Foundry Floor...

## Small Changes, Big Impact...

Every foundry is filled with activity...machines running, metal flowing, people responding to the rhythm of production. Yet, many of the most meaningful improvements on the shop floor begin quietly.

Molten metal does not interpret intent. It responds only to preparation, discipline, and consistency.

Over time, one realisation becomes clear: **the quality of a casting is often determined long before the metal is poured.**

It is shaped by how clearly expectations are defined, how closely processes are observed, and how effectively operators are enabled to act in the moment.

## A simple observation from the shop floor.

In many foundries, furnace temperature controls and displays are positioned away from the operator's immediate field of view. Once set during the start of the shift, they often remain unchanged unless a significant issue arises.

When critical temperature information is made visible and accessible at the operator panel, behaviour changes naturally.

- The operator can continuously see the temperature.
- Small drifts are noticed early.
- Corrections happen before defects appear.
- There is no new machine involved.
- No additional manpower required.
- No complex SOP revision.

Yet the impact can be meaningful...better temperature stability, improved consistency, and increased confidence on the shop floor. More importantly, it reinforces ownership with the person closest to the process.

When issues occur, it is easy to focus on equipment or parameters. Often, meaningful improvement begins by asking a simpler question:

## Are we enabling the right actions at the right time?

Operational excellence is rarely the result of dramatic change. It is built through steady attention to small details and thoughtful design of systems that support people in doing the right thing consistently.

- Machines deliver output.
- Processes ensure repeatability.
- People bring awareness and judgment.

This column is intended as a monthly pause...to reflect not only on what we do on the shop floor, but how and why we do it.

In the end, **results on the shop floor are never accidental... they are the outcome of daily improvements.**

**Happy die casting!**

**G Praburam**

Managing Director, Alubee Die Casters Pvt. Ltd.

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## **KERALA ADVANCES INDIA'S FIRST STATE-LED ELECTRIC TRUCK CORRIDOR ON NH-66**

State electricity board launches dedicated web portal as Kerala accelerates electric freight infrastructure development under PM E-DRIVE scheme, targeting busy national highway corridor with significant industrial traffic. Kerala is positioning itself to establish India's first state-led electric truck corridor along National Highway 66, a critical freight route that handles substantial port and industrial cargo movement across the state. The Kerala State Electricity Board Limited and the International Council on Clean Transportation convened a high-level workshop bringing together government officials, utilities, electric vehicle manufacturers, and logistics operators to develop the state's electric freight roadmap. At the event, Electricity Minister K. Krishnankutty unveiled a web portal designed to streamline implementation of the PM E-DRIVE scheme for privately owned lands. The platform enables eligible Charge Point Operators to register private land parcels meeting Category C requirements, facilitating systematic land aggregation for charging infrastructure proposals to the Ministry of Heavy Industries.

The PM E-DRIVE program allocates ₹2,000 crore toward developing electric truck and bus charging infrastructure along major national and state highways nationwide. Kerala demonstrated early initiative by submitting land proposals to the ministry before nodal agency designation. Following the release of operational guidelines, KSEBL assumed the nodal agency role and intensified land aggregation efforts. The state has established significant momentum in clean mobility, with over 300,000 electric vehicles registered and comprising more than 10 percent of new vehicle sales, among India's highest rates. NH-66 serves as Kerala's primary freight corridor, transporting industrial goods, port cargo, and construction materials. With Vizhinjam Port expansion and growing coastal industrial activity, freight volumes along this route are projected to increase substantially. State officials emphasized that structured electrification planning is essential to manage growing logistics emissions and congestion in densely populated districts including Ernakulam, Kollam, Kozhikode, Alappuzha, and Thiruvananthapuram. Medium and heavy-duty trucks represent major contributors to road transport pollution in India. Electrifying freight movement along NH-66 offers opportunities to improve air quality, reduce industrial operating costs, and strengthen competitiveness for Kerala's export sectors including rubber, seafood,

cashew, and plantations, which face increasing global climate and carbon disclosure requirements. KSEBL Chairman Minhaj Alam stated the board's responsibility involves translating the national program into a reliable, scalable charging ecosystem for medium and heavy-duty electric trucks. Additional Chief Secretary Puneet Kumar noted that submissions under PM E-DRIVE would emphasize high-capacity configurations of 120 kilowatt and 240 kilowatt charging systems, reflecting forward-looking planning for long-haul freight operations and next-generation truck platforms.

Transport Commissioner Nagaraju Chakilam indicated the department views mobility as both an energy consumer and potential provider. The state plans to develop charging infrastructure with wayside amenities for truck drivers, including facilities equipped with vehicle charging stations and real-time road condition information systems, in collaboration with the Ministry of Road Transport and Highways. Workshop participants identified high-impact freight electrification use cases, infrastructure deployment strategies, financing models for early adoption, and opportunities to align state actions with national programs. Through coordinated institutional efforts involving KSEBL, the Power Department, Motor Vehicles Department, EV Accelerator Cell, and local industries, Kerala aims to establish a benchmark for corridor-based electric freight transition in India.

## **AL INDUSTRY FACES STRUCTURAL EUROPE DECLINE**

The European aluminium industry has heard some highly optimistic forecasts for prices and demand recovery in 2026 at a series of late-year industry events that started with London Metal Exchange (LME) Week in October. But that optimism rests on assumptions of a sharp recovery in demand for which there is no real evidence, and concerns are growing that the extended downturn in European manufacturing represents a more structural shift in global industrial power. Some industry analysts forecast in October that LME aluminium prices could reach \$3,000/t by the end of 2025, and even threaten the \$4,000/t mark at some point in 2026. The forecasts assumed a continuation of the supply tightness that has become a major driver of global aluminium markets in 2025 as Chinese output has neared its production cap of 45mn t/yr and production growth has also slowed elsewhere, as many regions focus away from capacity expansion. But the bullish price projection was also supported by expectations of a

recovery in demand from manufacturing industries following a lengthy period of contraction, particularly in Europe. With demand levels for aluminium-intensive goods currently well below trend, those analysts foresee a much better demand outlook for next year. But the reality may be that the downturn in aluminium demand in Europe is more structural, and as a result there is no reason to expect a significant improvement just because it is due in an historical context.

The automotive sector is a particularly potent example. After a steep fall in manufacturing rates in 2020 because of the Covid-19 pandemic, Europe's automotive sector has yet to recover to 2019 levels. Production even fell back in 2024 by more than 6pc from the previous year on strong competition from China and lower consumer spending because of high inflation and rising interest rates. European car production fell further in the first half of 2025, by 2.6pc on the year as stricter emissions targets, high energy costs and US import tariffs hit output. Even relief in the form of falling interest rates or more affordable energy would not be enough to bring European car manufacturing back to 2019 levels. As European output has fallen, other countries have risen to take its place. Global car production grew by 3.5pc in the first half of this year, with Chinese output jumping by 12pc on the back of climbing electric vehicle (EV) sales, thanks to policy support and, crucially, rising exports. As Europe once led the world in internal combustion engine markets, so China is now leading in EVs.

"The European industry sold ICE [internal combustion engine] cars all over the world, including to China, but that era is now over," executive director of clean transport think tank Transport & Environment William Todts said at the European Aluminium Summit in Brussels last month. "Fifty percent of the Chinese market has gone, and the European market is shrinking. That transformation is extremely challenging." Europe must recognise this new world order and adjust its policy goals accordingly. Much of Europe's trade and industry policy was designed for the dominant global industries the region enjoyed in the past, and new policies must be enacted to support new markets or the downturn in European manufacturing will extend further and deeper. "I'm very worried about the downturn being structural. Europe has huge energy costs and I don't see carmakers growing against the Chinese competition," chief executive of aluminium products manufacturer HAI Group Rob van Gils said in Brussels. "I don't think it's a cycle and it will be very tough in the next couple of years," he added. "We need an evergreen approach. Europe is just surviving. It is not innovating. Industry is stuck."

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Corporate Member	1000	15000	16000	18880	1000	225000	226000	266680
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Inside pages	40232.5	47474	883.30	1042	8391.35	9902	201.1625	237

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## ADVERTISEMENT SIZES & FILE FORMAT

<b>Full Page</b>	<b>Final Trim Size:</b> Width 210mm X Height 297mm <b>Bleed:</b> 3mm all sides
<b>Half Page</b>	Width 180mm X Height 135mm (non-bleed)
<b>Quarter Page</b>	Width 90mm X Height 135mm (non-bleed)
<b>File Format</b>	Print ready PDF in CMYK color space. No spot colors. All fonts embedded & images @ 300dpi resolution

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### **Aluminium Casters' Association (ALUCAST)**

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Plot No. 45, 46A, 46B, Pune 411045

**T:** +91 20 27290014 **E:** alucastindia@alucast.co.in

Summary Report: Summary Report: Cumulative Production, Domestic Sales & Exports data for the period of April-November 2025

Report I - Number of Vehicles									
Category	Production			Domestic Sales			Exports		
Segment/Subsegment	April-November			April-November			April-November		
	2024-25	2025-26	% Change	2024-25	2025-26	% Change	2024-25	2025-26	% Change
<b>Passenger Vehicles (PVs)*</b>									
Passenger Cars	11,24,556	11,56,697	2.9%	8,64,804	8,51,099	-1.6%	2,70,884	3,04,095	12.3%
Utility Vehicles(UVs)	19,67,206	21,38,857	8.7%	17,61,981	18,51,896	5.1%	2,22,350	2,88,242	29.6%
Vans	1,03,154	1,09,505	6.2%	99,924	1,02,663	2.7%	5,529	6,931	25.4%
<b>Total Passenger Vehicles (PVs)</b>	<b>31,94,916</b>	<b>34,05,059</b>	<b>6.6%</b>	<b>27,26,709</b>	<b>28,05,658</b>	<b>2.9%</b>	<b>4,98,763</b>	<b>5,99,268</b>	<b>20.2%</b>
<b>Three Wheelers</b>									
Passenger Carrier	6,18,159	7,60,166	23.0%	4,16,719	4,56,835	9.6%	2,00,550	3,03,583	51.4%
Goods Carrier	79,349	81,463	2.7%	75,851	78,120	3.0%	2,852	3,549	24.4%
E-Rickshaw	16,150	8,956	-44.5%	14,558	9,315	-36.0%	34	23	-32.4%
E-Cart	2,763	3,253	17.7%	2,791	3,467	24.2%	-	-	-
<b>Total Three Wheelers</b>	<b>7,16,421</b>	<b>8,53,838</b>	<b>19.2%</b>	<b>5,09,919</b>	<b>5,47,737</b>	<b>7.4%</b>	<b>2,03,436</b>	<b>3,07,155</b>	<b>51.0%</b>
<b>Two Wheelers</b>									
Scooter/ Scooterette	51,19,455	56,53,075	10.4%	47,87,080	52,81,465	10.3%	4,02,862	4,34,839	7.9%
Motorcycle/Step-Throughs	1,10,30,255	1,15,07,930	4.3%	87,88,829	87,73,163	-0.2%	22,78,688	28,84,284	26.6%
Mopeds	3,59,661	3,34,532	-7.0%	3,58,096	3,37,213	-5.8%	5,094	14,334	181.4%
<b>Total Two Wheelers</b>	<b>1,65,09,371</b>	<b>1,74,95,537</b>	<b>6.0%</b>	<b>1,39,34,005</b>	<b>1,43,91,841</b>	<b>3.3%</b>	<b>26,86,644</b>	<b>33,33,457</b>	<b>24.1%</b>
<b>Quadricycle</b>									
Quadricycle	4,713	3,569	-24.3%	111	4	-96.4%	4,598	3,450	-25.0%
<b>Grand Total of All Categories</b>	<b>2,04,25,421</b>	<b>2,17,58,003</b>	<b>6.5%</b>	<b>1,71,70,744</b>	<b>1,77,45,240</b>	<b>3.3%</b>	<b>33,93,441</b>	<b>42,43,330</b>	<b>25.0%</b>

\* BMW, Mercedes, JLR, Volvo Auto data is not available and Tata Motors data is available for Apr-Sep only. Society of Indian Automobile Manufacturers (12/12/2025)

Summary Report: Cumulative Production, Domestic Sales & Exports data for the period of April-December 2025

Report I - Number of Vehicles									
Category	Production			Domestic Sales			Exports		
Segment/Subsegment	April-December			April-December			April-December		
	2024-25	2025-26	% Change	2024-25	2025-26	% Change	2024-25	2025-26	% Change
<b>Passenger Vehicles (PVs)*</b>									
Passenger Cars	12,63,659	13,38,823	5.9%	9,76,515	10,03,112	2.7%	3,12,850	3,39,367	8.5%
Utility Vehicles(UVs)	22,69,689	25,02,624	10.3%	20,48,720	22,05,770	7.7%	2,58,870	3,23,899	25.1%
Vans	1,15,973	1,25,809	8.5%	1,14,053	1,18,275	3.7%	6,371	7,664	20.3%
<b>Total Passenger Vehicles (PVs)</b>	<b>36,49,321</b>	<b>39,67,256</b>	<b>8.7%</b>	<b>31,39,288</b>	<b>33,27,157</b>	<b>6.0%</b>	<b>5,78,091</b>	<b>6,70,930</b>	<b>16.1%</b>
<b>Commercial Vehicles (CVs) - M &amp; HCVs</b>									
Passenger Carrier	44,667	60,626	35.7%	44,524	47,224	6.1%	7,389	12,184	64.9%
Goods Carrier	2,30,604	2,48,338	7.7%	2,14,838	2,35,495	9.6%	8,431	12,954	53.6%
<b>Total M&amp;HCVs</b>	<b>2,75,271</b>	<b>3,08,964</b>	<b>12.2%</b>	<b>2,59,362</b>	<b>2,82,719</b>	<b>9.0%</b>	<b>15,820</b>	<b>25,138</b>	<b>58.9%</b>
<b>Commercial Vehicles (CVs) - LCVs</b>									
Passenger Carrier	45,451	43,855	-3.5%	36,497	41,312	13.2%	3,017	3,491	15.7%
Goods Carrier	4,15,158	4,59,825	10.8%	3,89,010	4,30,036	10.5%	38,295	39,511	3.2%
<b>Total LCVs</b>	<b>4,60,609</b>	<b>5,03,680</b>	<b>9.4%</b>	<b>4,25,507</b>	<b>4,71,348</b>	<b>10.8%</b>	<b>41,312</b>	<b>43,002</b>	<b>4.1%</b>
<b>Total Commercial Vehicles (CVs)</b>	<b>7,35,880</b>	<b>8,12,644</b>	<b>10.4%</b>	<b>6,84,869</b>	<b>7,54,067</b>	<b>10.1%</b>	<b>57,132</b>	<b>68,140</b>	<b>19.3%</b>
<b>Three Wheelers</b>									
Passenger Carrier	6,81,654	8,48,973	24.5%	4,59,095	5,06,320	10.3%	2,25,133	3,42,871	52.3%
Goods Carrier	88,089	92,994	5.6%	84,934	89,276	5.1%	2,956	3,842	30.0%
E-Rickshaw	16,581	9,863	-40.5%	15,656	10,222	-34.7%	34	23	-32.4%
E-Cart	2,920	3,640	24.7%	2,967	3,843	29.5%	-	-	-
<b>Total Three Wheelers</b>	<b>7,89,244</b>	<b>9,55,470</b>	<b>21.1%</b>	<b>5,62,652</b>	<b>6,09,661</b>	<b>8.4%</b>	<b>2,28,123</b>	<b>3,46,736</b>	<b>52.0%</b>
<b>Two Wheelers</b>									
Scooter/ Scooterette	55,87,158	63,41,918	13.5%	52,05,745	58,76,209	12.9%	4,45,657	4,96,805	11.5%
Motorcycle/Step-Throughs	1,20,54,852	1,29,07,978	7.1%	94,42,637	96,73,322	2.4%	26,10,724	32,91,765	26.1%
Mopeds	3,94,490	3,82,568	-3.0%	3,91,188	3,83,346	-2.0%	5,274	14,388	172.8%
<b>Total Two Wheelers</b>	<b>1,80,36,500</b>	<b>1,96,32,464</b>	<b>8.8%</b>	<b>1,50,39,570</b>	<b>1,59,32,877</b>	<b>5.9%</b>	<b>30,61,655</b>	<b>38,02,958</b>	<b>24.2%</b>
<b>Quadricycle</b>									
Quadricycle	5,553	4,155	-25.2%	116	4	-96.6%	5,456	4,020	-26.3%
<b>Grand Total of All Categories</b>	<b>2,32,16,498</b>	<b>2,53,71,989</b>	<b>9.3%</b>	<b>1,94,26,495</b>	<b>2,06,23,766</b>	<b>6.2%</b>	<b>39,30,457</b>	<b>48,92,784</b>	<b>24.5%</b>

\* BMW, Mercedes, JLR and Volvo Auto data are not available. \*\* Daimler data is not available. Society of Indian Automobile Manufacturers (13/01/2026).

# Bühler showcased advanced die-casting solutions for cost-efficient production at Euroguss 2026



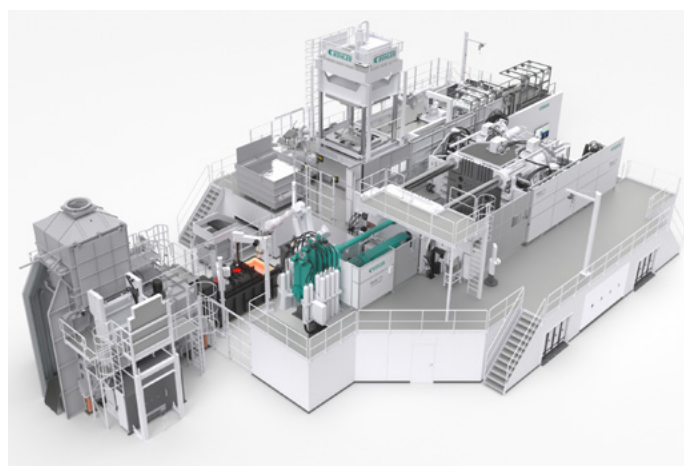
Die-casting manufacturers face rising costs and increased competition across the industry, alongside growing interest in large-structural approaches such as megacasting. Meeting these demands requires targeted investment and strong partnerships. At Euroguss 2026, Bühler presented its latest innovations designed to improve overall production efficiency and reduce manufacturing costs across the die-casting process. Highlights included the Carat 720, Ecoline DS, intelligent cell control systems for all die-casting cell sizes, and a comprehensive service portfolio across production scales.

For decades, Bühler's Die Casting business has been at the forefront of developing advanced solutions for aluminum and magnesium die casting across automotive, household appliance, and telecommunication sectors. By combining innovation with customer-centric design, Bühler offers a broad portfolio of equipment with locking forces ranging from 2,600 to 92,000 kilonewtons (kN), ensuring solutions for every application.

## INTRODUCING THE CARAT 720

The Carat 720 is the latest addition to Bühler's proven Carat series, which boasts over 950 installations worldwide. It offers a locking force of 72,000 kN and features an optimized machine design with a new tie-bar geometry for a compact footprint and seamless integration. Engineered for maximum efficiency, the Carat 720 delivers faster cycle times, superior part quality, and simplified handling, making it the ideal solution for high-performance megacasting.

With more than 50 megacasting cells sold globally and three regional hubs in Europe, North America, and Asia, Bühler provides unmatched expertise and support throughout the entire process of megacasting, from part design and layout planning to commissioning. Today, Bühler's customers supply parts for over 15 OEMs worldwide.



Carat 720 megacasting cell

## ECOLINE DS

The 3-platen locking system on the Ecoline DS has already proven itself in over 3,000 die-casting applications worldwide. The toggle system ensures fast movements with an evenly distributed locking force. The tie-bars with special Bühler thread design allow for consistent production with minimum downtime and minimal maintenance. Die-filling at high speed and extreme pressure is a foundational requirement for today's complex die castings.

Machines of the Ecoline DS series use state-of-the-art proportional technology to control the high-power injection unit, overcome process variations, and deliver high-quality parts. Optimization algorithms combined with regenerative hydraulics minimize air entrapment and save energy at the same time.

The high-performance injection unit of the Ecoline DS combined with the assistance systems enables an increased productivity of up to 5% and decreased scrap of up to 5%.



Ecoline DS

## SMART CELL CONTROL FOR ENHANCED PRODUCTIVITY

Whether it is megacasting or smaller die-casting solutions, Bühler's cell control systems bring all die-casting cell devices under one integrated system, enabling operators to monitor, control and program the entire cell from a single touchpoint. This streamlined approach reduces downtime and boosts productivity across setups of any size, from simple configurations to fully automated megacasting cells. While SmartCMS offers comprehensive control for larger plants, smaller cells benefit from DataView integration. In addition, the Bühler Insights Digital Services are available for all cell sizes. These solutions accelerate production changes with intelligent recipe management, ensure consistent product quality through advanced tracking, and minimize downtime thanks to real-time alarms and diagnostics.



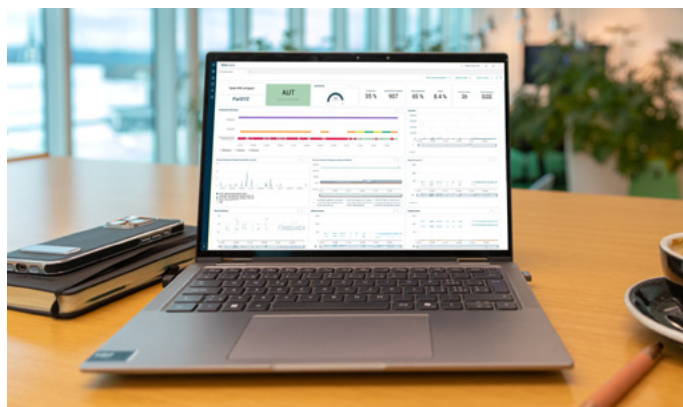
Bühler DataView

## COMPREHENSIVE SERVICES FOR LONG-TERM SUCCESS

Bühler provides customers with expert support at every stage of the product life cycle, from transforming initial component ideas into practical implementations to full remanufacturing of machines. This commitment to comprehensive support ensures customers can consistently reach their production goals with confidence, knowing Bühler stands alongside them every step of the way.

With more than 100 service stations worldwide and over 200 highly trained die-casting specialists, Bühler ensures that its experts understand each customer's processes, applications, and the technical details of their cells. The company shares best practices and innovations from around the globe while tailoring personalized solutions to meet specific needs and immediate challenges.

Through Bühler Total Care service agreements, customers benefit from customizable on-site service packages and hands-on training for their teams. This approach enhances employee expertise, reduces downtime, and ensures that die-casting cells continue to operate at peak efficiency over time.



Bühler Insights dashboard

**Your feedback is appreciated!** Do you have any additional wishes to improve your digital experience, or are you missing any features? Get in touch with us directly at: [die-casting@buhlergroup.com](mailto:die-casting@buhlergroup.com)