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FOCUS

ISSUE 1(FY 24-25)

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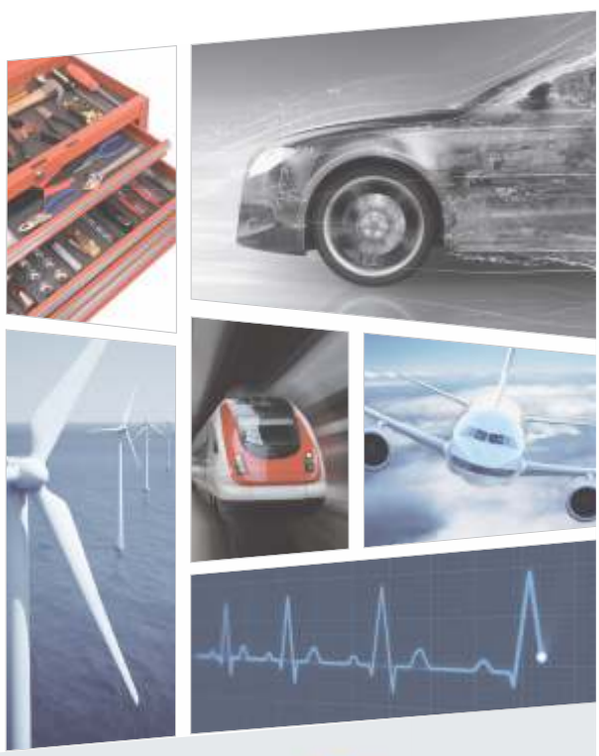

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CONTENT

From the Editor's Desk

India is the world's fifth largest economy and Industry is confident that Prime Minister Narendra Modi-led NDA government will take the Indian economy to even greater heights and emerge among the top three in the world in the next few years. Shri Narendra Modi has assumed his third term office at a time when Indian economy continued to record strong growth, clocking an expansion of 8.2 per cent in 2023-24. The Reserve Bank of India has projected India's FY25 real GDP forecast to 7.20 per cent. However, the challenges such as geopolitical situation, high inflation , FTA negotiations etc. demand immediate attention.

We in Forging industry welcome the union budget. It lays out a comprehensive roadmap for 'Viksit Bharat' across key sectors including manufacturing and services. The emphasis on promoting MSMEs through enhanced credit support and infrastructure development is particularly commendable. The special attention given to MSMEs, particularly labour-intensive manufacturing, through financing, regulatory changes, and technology support, is a crucial step toward enhancing global competitiveness. The financial support for shifting micro and small industries to cleaner forms of energy and the facilitation of investment-grade energy audits in 60 clusters with expansion to 100 clusters, will greatly benefit MSMS units in the Forging sector. These measures will not only bolster job creation but also enhance competitiveness, paving the way for a robust industrial growth trajectory.

AIFI will continue to contribute towards growth and making India world's third largest economy. We are pleased to share that continuing our efforts to provide engaging activities to the members, AIFI secretariat is initiating number of new activities and training programmes. We are currently working on updating our members' directory , which is set to be completed by the October 2024.

Happy reading !

Editorial Board

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MACROECONOMIC FACTORS OF THE INDIAN ECONOMY

Abstract

The Indian economy closed FY24 strongly with its growth surpassing market expectations, despite strong external headwinds. Early indications suggest a continuation of the economic momentum during the first quarter of FY25. The emerging robust trends in important high frequency indicators of growth like the GST collections, e-way bills, electronic toll collections, sale of vehicles, purchasing managers' indices and the value and number of digital transactions attest to the growing strength of the economy.

Industrial activity is gaining momentum. This is clear from improving industrial capacity utilisation and volume indicators like the Index of Industrial Production and Purchasing Managers' Index (PMI) for manufacturing. Concurrently, fixed investment is gathering pace on the back of the focus of the Government on capital spending and the resultant crowing in of private investment. The forward-looking surveys of the Reserve Bank also indicate improving consumer confidence and industrial outlook.

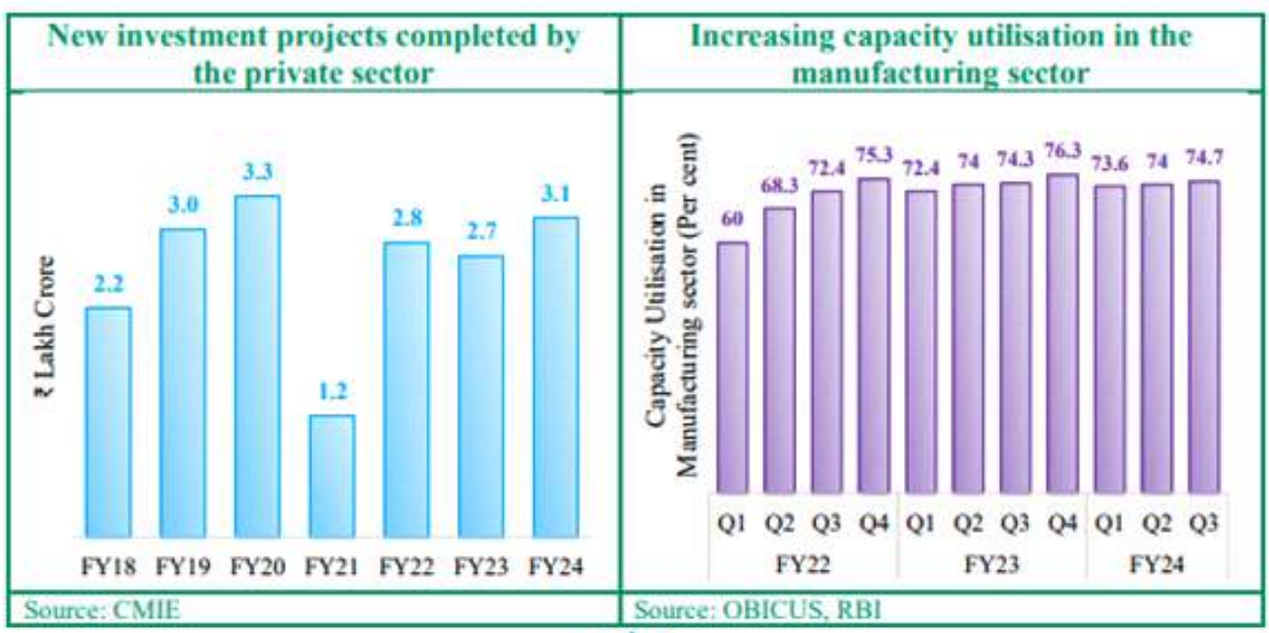
The job market trends are reassuring. While the urban unemployment rate declined y-o-y during the quarter ending March 2024, the labour force participation rate and worker-topopulation ratio have improved. Formal jobs are rising, as indicated by the growing net payroll additions under the Employee Provident Fund Organisation.

Along with growth and employment, the other macroeconomic indicators are also improving. Retail inflation clocked 4.83 per cent in April 2024, the lowest in the past 11 months. On the external front, despite global challenges, India's foreign exchange reserves are comfortable, and the Indian rupee has been one of the most resilient vis-à-vis the US dollar in recent months. From the fiscal angle, robust trends in the capital spending of the general government during April-February of FY24, combined with the fiscal consolidation plans reflected in the Budget for FY25, have laid to rest concerns about debt sustainability. Thus, the major pillars of India's macro-economic strength, including growth, price stability and fiscal management, are directionally positive and mutually reinforcing.

The unrelenting geopolitical tensions and volatility in global commodity prices, especially of petroleum products, present substantial multi-frontal challenges. Nonetheless, the expectation is that the macro-economic buffers nurtured and strengthened during the post-Covid management of the economy will help the Indian economy navigate these challenges reasonably smoothly.

The CMIE data on new investment announcements serves as an indicator for corporate capex plans. These figures represent intentions, which may or may not materialise, but they do mirror the sentiments and expectations of the companies.

The overall scenario is promising, with a significant improvement compared to the pre-COVID era, despite the intentions being lower than the previous year. In FY24, the private sector announced new investment projects worth ₹23.5 lakh crore, much higher than the past five years' average of ₹14.4 lakh crore. Despite new investment projects announced by the private sector being lower in FY24 compared to the previous year, the investment projects completed by the private sector witnessed a significant uptick to ₹3.1 lakh crore in FY24 from ₹2.7 lakh crore in FY23.

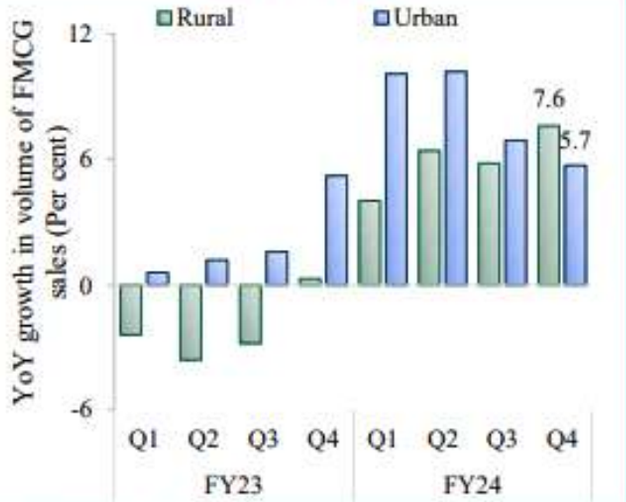


The upbeat investment environment is accompanied by increased capacity utilisation in the manufacturing sector, as seen in the RBI's quarterly Order Books, Inventory and Capacity Utilisation Survey (OBICUS) for Q3 of FY24.2 The aggregate capacity utilisation in the manufacturing sector picked up significantly from 74 per cent in Q2 to 74.7 per cent in Q3 of FY24. Manufacturing companies received a larger number of orders during this quarter as compared to the corresponding quarter of the previous year.

Stronger Rural and Urban Demand Conditions

While investment activity remains expansive, consumption is being propelled by consistent growth in urban demand and a resurgence in rural demand, thereby contributing to India's growth in FY24. As per the data published by Nielsen IQ, the volume sales of fastmoving consumer goods (FMCG) in rural markets saw a rise of 7.6 per cent in the Q4 of FY24 on a yoy basis. For the first time in five quarters, rural FMCG demand growth outpaced urban growth.

Rise in rural FMCG volume sales growth in Q4 of FY24



Source: Nielsen IQ

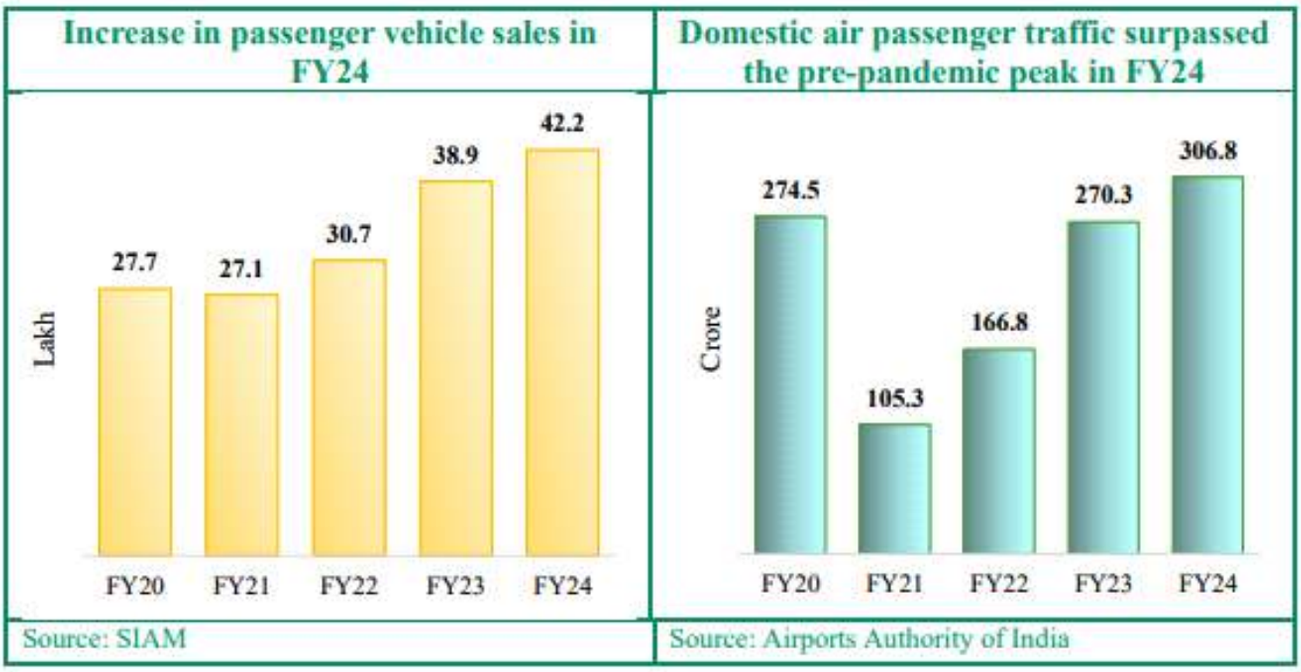
Highest two & three-wheeler sales recorded in FY24

Source: Society of Indian Automobile Manufacturers (SIAM)

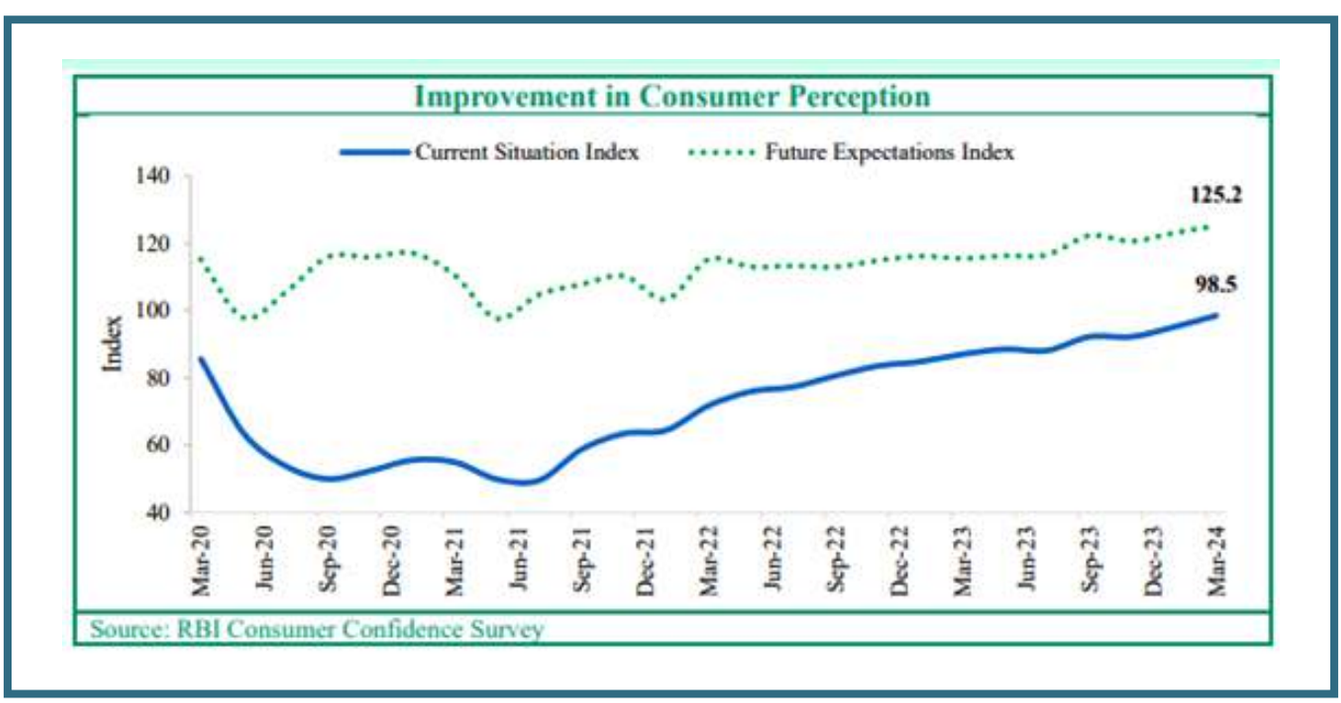
- Other indicators of rural demand also demonstrate a robust growth in consumption activity in FY24. Two and three-wheeler sales increased by 14.2 per cent in FY24, at 186.7 lakh compared to 163.5 lakh in FY23, due to enhanced model availability, new product introduction and positive market sentiments. Carrying the momentum in FY25, two-wheeler sales registered a remarkable growth of 30.8 per cent in April 2024 on a yearly basis.

- The resilience of urban demand is evident in the robust growth of housing personal loans, which increased by 36.9 per cent in FY243 . Sales of passenger vehicles saw a rise of 8.4 per cent in FY24, spurred by the launch of cost-effective compressed natural gas fuel options and new electric models, coupled with positive market sentiment and the provision of high-quality after-sales service.

- The robust consumption demand in urban areas is also reflected in rising domestic air passenger traffic. In FY24, domestic air passenger traffic surpassed the pre-pandemic peak, driven by a growing demand for air travel. The momentum in urban demand persisted in FY25, buoyed by positive consumer sentiment and festive celebrations.



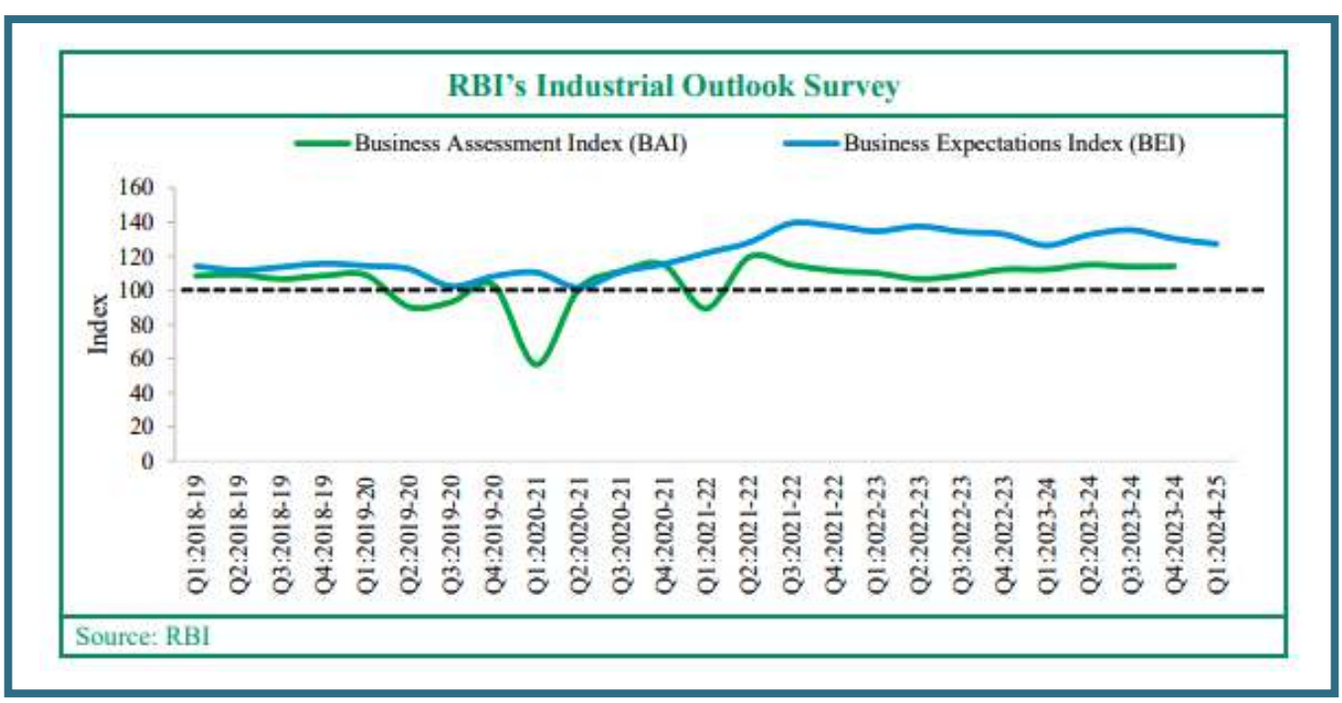
According to the RBI's consumer confidence survey for April 20244 , the Current Situation Index (CSI) rose by 3.4 points to 98.5 in March 2024, the highest level since mid2019. Consumers are quite optimistic about the general economic situation, income and spending. Consumer confidence for the year ahead improved further on the back of optimism in almost all parameters, such as economic situation, employment, income and spending. The Future Expectations Index (FEI)5 also rose further by 2.1 points to 125.2, also its highest level since mid-2019



Robust Growth in Industrial Activity in FY24

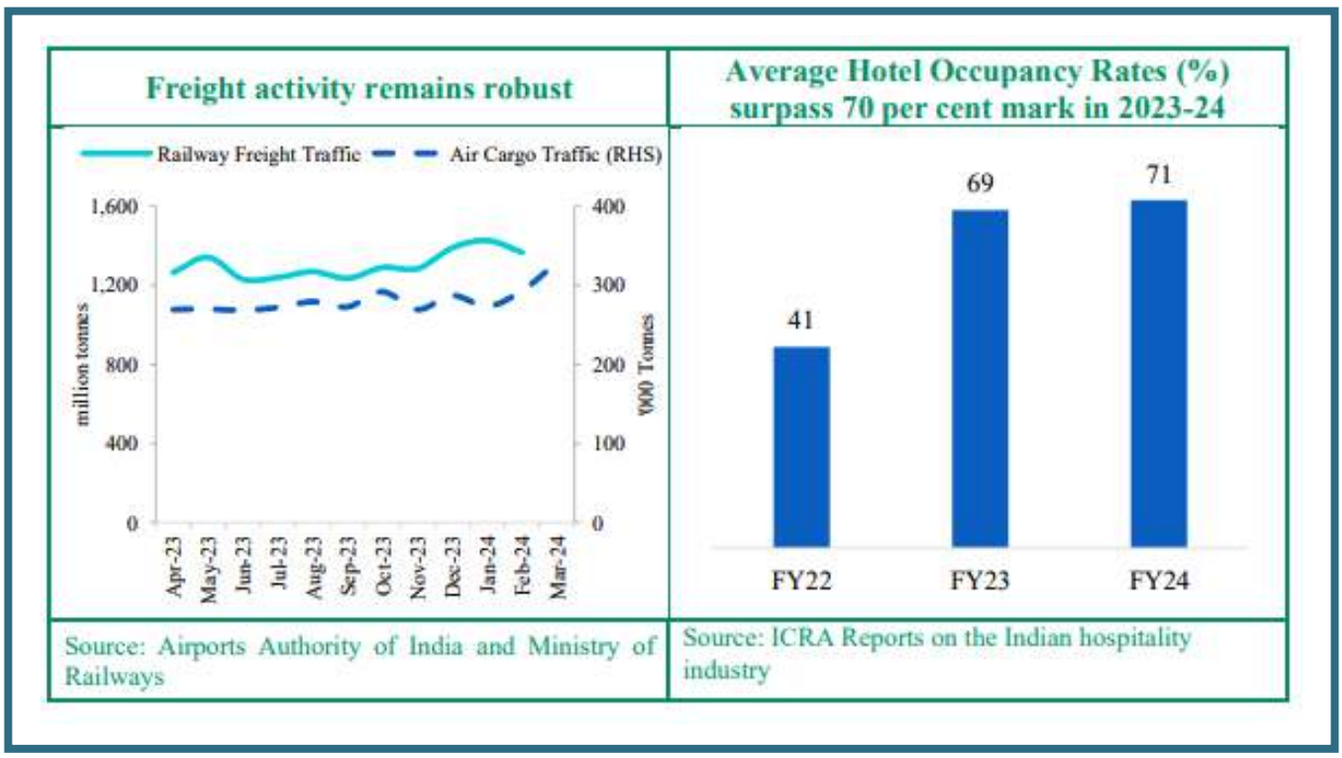
Industrial output continues to expand in March 2024, with the Index of Industrial Production (IIP) increasing by 4.9 per cent in March 2024. IIP grew by 5.8 per cent in the fiscal year FY24. It is important to note that IIP is a volume index, and its growth cannot be readily compared with that of value indices (either at current prices or at constant prices). Manufacturing sector output expanded to a five-month high of 5.2 per cent in March 2024, lifting the overall growth performance for this segment in the 2023-24 to 5.5 per cent.
Basic metals, motor vehicles, trailers and semi-trailers and coke and refined petroleum products were the major catalysts to overall growth.

The manufacturing activity maintained its growth trajectory from the previous year, with the Manufacturing PMI for April remaining in the expansionary zone, supported by strong demand conditions, which resulted in a further expansion of output. Improvements in delivery times from suppliers contributed to the increased purchasing activity. Furthermore, a positive outlook for the year ahead prompted firms to expand their workforce.

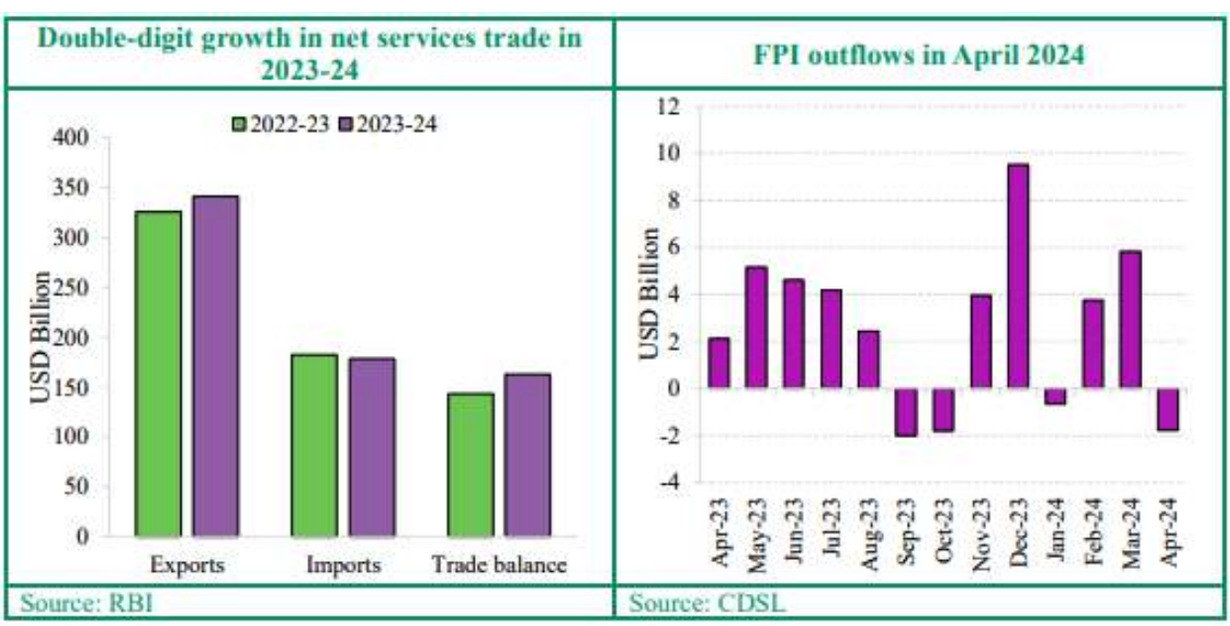


Business sentiments remain upbeat as per the RBI's 105th round of the Industrial Outlook Survey (IOS). Manufacturers continue to be optimistic about demand conditions in Q1 of FY25, with well over half of the respondents reporting a rise in production, order books and overall business situation. With the manufacturing sector capacity utilisation is rising above the long-term average, the increase in new investment announcements by the private sector remains positive for growth.

India's transportation sector has seen a significant increase in activity recently, with a surge in passenger travel and freight transport. In March 2024, there was a 15 per cent increase in domestic air passengers, a 6 per cent increase compared to February 2024. Rail freight traffic also increased by 4.9 per cent yoy, amounting to 1434 million tonnes from April 2023 to February 2024. Fuel usage in April 2024 increased by 6.1 per cent yoy, totalling over 19.9 million tonnes, supporting the growth in physical connectivity.



Gross Foreign Direct Investment (FDI) inflows in FY24 stood at USD 71.0 billion, compared to USD 71.4 billion in FY23. The 2024 Kearny FDI Confidence Index9 ranked India 4th in the EME category, underscoring its attractiveness as an FDI destination despite moderation and volatility in global capital flows.



Performance of High-Frequency Indicators

Date Title	Unit	YTD Period/As at the end of	Year to Date			Year to Date(YoY Growth)		
			2022-23	2023-24	2024-25	2022-23	2023-24	2024-25
Agriculture								
Fertiliser Sales	Mn Tonnes	Apr	4.4	3.7	3.7	66.7	-15.3	-1.8
Domestic Tractor Sales	Lakh	Apr	0.9	0.8	0.8	40.6	-11.1	-3.0
Foodgrain Production(Kharif+Rabi)*	Mn Tonnes	2nd AE	313.6	309.3		4.5	-1.3	–
Reservoir Level	Bn Cu Metres	16-May	56.8	57.4	45.3	8.4	1.1	-21.1
Wheat Procurement(RMS)	LMT	21-May	181.6	249.0	260.5	–	37.1	4.6
Rice Procurement(KMS)	LMT	21-May	491	476		1.8	-3.1	–
Forecast Rainfall	% of LPA	June-Sep	99.0	96.0	106.0	1.0	-3.0	10.4
Credit to Agriculture and allied activitics	1 Lakh crore	March	15.0	17.3	20.7	12.6	15.3	19.7
Industry								
IIP	Index	Apr-Mar	138.5	146.6	–	5.3	5.9	–
8-Core Industries	Index	Apr-Mar	146.7	157.7	–	7.8	7.5	–
Domestic Auto sales	Lakh	Apr	14.2	17.1	21.4	11,9	20.5	24.7
PMI Manufacturing	Index	Apr	54.7	57.2	58.8	-1.4	4.6	2.8
Power consumption	Billion kWh	Apr	134.1	132.5	143.8	14.1	-1.2	8.5
Natural gas Production	Bn Cu. Metres	Apr-Mar	34,4	36,4	–	1.3	5.8	–
Cement Production	Index	Apr-Mar	170.6	186.3	–	8.7	9.2	–
Steel consumption	Mn Tonnes	Apr	9,1	10	11.1	1.8	9.5	10.9

Note: Foodgrain production data for 2022-23 is final estimate

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COMPARISON OF NATURAL GAS FIRED AND INDUCTION HEATING FURNACES

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ABSTRACT

Generally, in steel processing systems, steels are heated via induction or combustion furnaces. Natural gas fired furnaces have installation costs advantage and induction furnaces have the advantages of less scale formation on the surface of the workpiece as well as environmental reasons. The operation cost of both systems is a vital argument to be solved. In this paper, a natural gas fired and an induction, heating furnaces of a forging process were studied. Thermodynamic analysis was performed for the furnaces which heats the work piece up to 1300 C. The energy performances of both systems were analyzed and compared. For the heating process a hybrid furnace was suggested.

INTRODUCTION

To bequeath habitable environment, today's world has to pay attention to energy sources and usages. This well, known truth forced to change the energy policies of entire world. Today many countries encourage the tendency of energy production to the renewable resources. However, fossil fuels cannot be given up suddenly due to both the number of installed power plants and their low efficiencies. So, the critical energy demand cannot be individually supplied by renewable resources. Since the installed powers of renewables are not sufficient yet, the energy saving applications or saved energy is also assumed to be renewable by most academic communities.

INDUCTION HEATING

Induction heaters are used to provide alternating electric current to an electric coil (the induction coil). The induction coil becomes the electrical (heat) source that induces an electrical current into the metal part to be heated (called the workpiece). No contact is required between the workpiece and the induction coil as the heat source, and the heat is restricted to localized areas or surface zones immediately adjacent to the coil (1). It provides faster and more precise heating of local areas, consumes less energy and is considered environmentally friendlier than other methods. Other advantages also include lower labor cost for device operators, easy maintainability of the equipment, quality assurance, automation capability and high reliability. Induction heating is a complex process including electromagnetic, thermal and metallurgic phenomena. In this process an alternating electric current induces electromagnetic field, which in turn induces eddy currents in the workpiece. The induced eddy currents release energy in the form of heat, which is then distributed throughout the workpiece (2). Laborelec (3) indicated that the principle of induction heating is mainly based on two well, known physical phenomena, electromagnetic induction and the Joule effect. The energy transfer to the object to be heated occurs by means of electromagnetic induction.

It is known that an alternating current is induced in a loop of conductive material when this loop is placed in an alternating magnetic field. The formula is as follows:

$U=d\phi/dt$

Were U is voltage (V), ϕ is magnetic flux (Wb) and t is time (s). When the loop is short,circuited, the induced voltage U will cause a current to flow that opposes its cause,the alternating magnetic field. This is the Faraday, Lenz law. If a massive conductor (e.g. a cylinder) is placed in the alternating magnetic field instead of a short,circuited loop, eddy currents (Foucault currents) will be induced (see Figure 1).

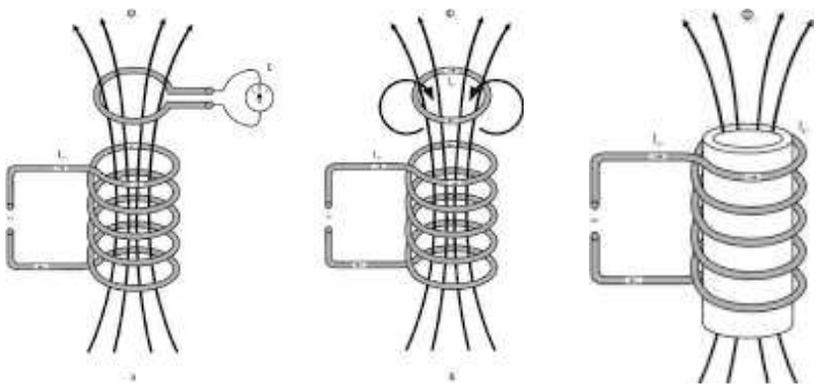

Figure 1:Faraday induction law

The eddy currents heat up the conductor according to the Joule effect. When a current I [A] flows through a conductor with resistance R [O], the power is dissipated in the conductor. In most applications of induction heating, the determination of resistance R is not a simple matter due to the non, uniform distribution of current in the conductor.

Haimbaugh stated that power requirements are related to the amount of energy required to heat a workpiece and to the induction heating system power losses. The energy or heat content required to heat the workpiece can be calculated when the material, its specific heat, and the effective weight of material to be heated per hour are known. Higher power densities provide the ability to heat surfaces more rapidly. However, there may be limitations to the amount of power that an individual induction coil can handle (1). Power induced in the workpiece can be determined as: $P=U.I=R.I^2$

Where P is the power (kW). In literature there are several studies focused on heating of metal. In this study, since our scope is the heating of steels for hot forging, we allowed for data of the papers that are related to our subject.

Table 1. Power consumptions of various metals for hot forging heating. (4)

	Steel	Aluminum	Copper	Brass (CuZn 70/30)
Forging Temperature (ºC)	1250	500	900	750
Power Induced (kWh/ton)	240	136	105	90
Power Consumed (kWh/ton)	350 – 400	280 – 300	230 – 250	180 – 190
Frequency (Hz)	50 – 10.000	50 – 4.000	50 – 4.000	50 – 4.000

Table 2. Average Power Requirements For Induction Heat Processing Of Common Metals (5) (kWh/tons)

Process	Carbon Steel	Magnetic Stainless Steel	Nonmagnetic Stainless Steel	Brass
Hot Forging	440,9	413,4	474,0	440,9
Hardening/Aging	275,6	286,6	-	358,3
Annealing/Normalizing	248,0	231,5	413,4	413,4
Warm Forming	192,9	-	275,6	-
Stress Relieving	165,3	55,1	220,5	220,5
Tempering	77,2	77,2	110,2	-
Curing of Coatings	55,1	55,1	82,7	121,3

The efficiency should also consider .The electrical efficiency is defined as follows (3, 9):

$$\eta_e = \frac{\dot{Q}_w}{\dot{Q}_e}$$

η_e : Electrical efficiency
$\dot{Q}_w$: Required energy for heating material (kW)
$\dot{Q}_e$: Electric Energy Consumed (kW)

In the following Table 3 Laborelec (3) has given the efficiencies of induction systems as to frequency converters

Table 3. Induction installations general aspects with various frequency converters (3)

	thyristors	transistors	tubes
Efficiency	90-97%	75-90%	55-70%
Frequency range:	100 Hz - 10 kHz	up to 500 kHz	up to 3000 kHz
Power range:	up to 10 MW	up to 500 kW	up to 1200 kW

The costs are also compared. Poncin (4) indicated that, heating a steel workpiece to 1250 oC consumes 350 kWh / ton. The data was provided from the workpiece that has widest diameter passing through the conductor.
Efficiency reduces with diameter decrease by means of the increment of air gap between the workpiece and inductor.

Table 5. Actual heating costs of various processes given by Poncin (4)(Euro/ton).

	Induction	Gas	LPG
Labor	3,85	7,7	7,7
Fuel	28,02	13,27	56,04
M&O	2,98	5,95	5,95
Scale Losses	2,23	11,15	11,15

Amortisation Costs	15,37	7,68	7,68
TOTAL	52,45	45,75	88,52

Table 6. Installation costs of induction and gas fired furnaces given by Mortland (5).

Item	Induction Furnace	Gas-Fired Furnace
Installed Cost	$600,000	$200,000
Heating Efficiency	60%	15%
Annual Energy Cost	$720,000	$540,000
Scale Loss	1/2%	2%
Scrap Loss	1/4%	1%
Annual Scrap and Scale Loss Cost	$150,000	$600,000
Labor Requirement	1 Operator 1/4 Maintenance	2 Operators 1/2 Maintenance
Annual Labor Cost	$60,000	$120,000
Total Annual Operating Cost	$930,000	$1,230,000

The advantages of induction furnaces are aligned as follows (3,6)

TECHNICAL PROCESS

- Maintenance costs and spare parts costs are fair.
- High power density provides a compact installation and realize a quick heating.
- Floor space requirements are less.
- Induction offers the possibility of reaching very high temperatures
- Induction heating can be applied to specific area of workpiece
- Induction installations are suited for automation
- Recovers time and heat losses during feeding and receiving of work piece.
- No need to stock fuel.
- A significant portion of the heat losses can be recuperated
- Extreme purity is possible by working in a vacuum or in inert atmospheres
- The precise location of heating can be determined accurately
- The heating can be regulated precisely
- Environment and working conditions
- No production of flue gasses
- Induction installations generally have good efficiency although this efficiency also depends upon the characteristics of the material to be heated.

Stefan and Günter recommended a hybrid furnace system that includes both with natural gas fired and induction furnaces. They advised that the material would heated up to 700,800 oC via the gas fired furnace and to 1200,1300 oC via induction furnace to avoid scale formation (7).

NATURAL GAS FIRED FURNACES

Natural gas fired furnaces (NGF) are somewhat simpler than the induction furnaces. You can see and hear the process in the furnace. The elements are familiar and known. These furnaces can be assumed as bigger scaled furnaces of our domestic ones. Therefore, most of the systems which are used in NGF are conventional e.g. loading system, walls, gas systems.

In NGF, main energy input is the combustion of natural gas. The electric, which is used to run the burners and air fans, may be considered as auxiliary energy. The total energy input via natural gas combustion can be calculated as;

$$\dot{Q}_f = \dot{m}_f \,.\, LHV \ \text{(kW)}$$

Where is the mass flow rate of natural gas (kg/s) and % is the Lovest Heating Value. Energy of flue gases may be calculated as;

$$\dot{Q}_{ex} = \dot{m}_{ex} \,.\, C_{ex} \,.\, (T_{ex} - T_o) \ \text{(kW)}$$

The workpiece that is loaded to furnace may be at environment temperature or any pre,heat temperature. Even case the temperature difference can be calculated as the difference between inlet and exit temperatures. Thus, the total energy transferred to the work piece in the furnace can be calculated from;

$$\dot{Q}_w = \dot{m}_w \,.\, C_w \,.\, (T_w - T_o) \ \text{(kW)}$$

Where $\dot{m}_w$ is the mass of workpiece loaded in 1 hour (kg/h), &! is the specific heat of work piece in (kJ/kgoC) and ! is the final temperature of the work piece (K). The radiation heat transferred from the hot surfaces simply can be calculated from;

$$\dot{Q}_r = \sigma \,.\, \varepsilon \,.\, A \,.\, (T_s^4 - T_o^4) \ \text{(kW)}$$

The heat transfer via turbulent flow natural convection from the hot surfaces can be calculated from;

$$\dot{Q}_{nc} = \left[1{,}32 \,.\, \sqrt[3]{T_y - T_o}\right] \,.\, A \,.\, (T_y - T_o) \ \text{(kW)}$$

The efficiency of a NGF can be obtained via direct and indirect methods. In the Indirect method, percentage of all losses through the total energy input must be calculated. In the direct method, proportion of the heat transferred to the workpiece to the total energy input via natural gas combustion can be calculated via the following equation.

$$\eta_\Sigma = \frac{\dot{Q}_w}{\dot{Q}_f}$$

RESULT AND DISCUSSION

The NGF considered in this study was installed 35 years ago, which has an old technology (Figure 1). The furnace has no exhaust system and naturally, has no recuperator or regenerator. The flame was blow out from the openings of the hatches. Thus, the thermal losses from the NFG were not based on only the radiation from the hot surfaces and exhaust gases. The opening losses were highly effective because of more than 1300 oC flame leakage. That means, the energy of flame with its radiation potential is inconsumable.

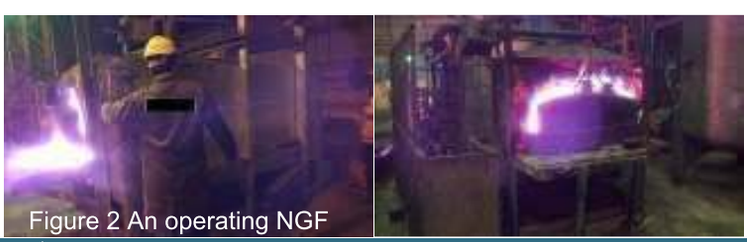

Figure 2 An operating NGF

In NGF systems, burners provide a stable combustion. By this means, it is easy to evaluate the volumetric or mass flow rate of natural gas. When natural gas flow rate read, total energy consumption can be easily calculated via the Eq. 4. In this study, Lowest Heating Value (LHV) of natural gas was taken from IZGAZ (Official Gas Distribution Company).

Table 7. Design Data and Energy Analysis of NGF

Fuel Consumption per Unit Time (sm3/h)	49,5
Lowest Heating Value of Natural Gas (kWh/Sm3)	10,64
Energy Consumption per Unit Time (kWh/h)	527
Combustion Time to Attain Steady State (h)	3
Natural Gas Consumption Until Steady State (sm3/h)	149
Total Energy Consumption Until Steady State (kW)	1580
Energy Requirement of 1 Tons of Steel (Design Capacity) (kW/h)	181
Energy Requirement of Steel Forged in Unit Time (Actual Data) (kW/h)	30
Q_{ex} Exhaust Losses (kW)	162
Q_{hs} Radiation Losses (kW)	25
Q_n Natural Convection Losses (kW)	19
Q_o Opening Losses (kW)	140
Q_T Total Heat Losses (kW)	205
Efficiency (Design Data) %	34,44
Efficiency (Actual Data) %	5,74

The results of the calculations and design data of the system, which was handled with in this study, were given

The results of the calculations and design data of the system, which was handled with in this study, were givenin Table 7. The exhaust losses were obtained via Eq. 5. It was considered that all the 1300 oC hot stack gases were lost with their energy potential, since the NGF system has no exhaust, recuperator or regenerator. In the system, even some of the flame was thrown out from the openings of the furnace. In most of the applications, the opening losses obtained 5% of the total energy input. However, in this study it was calculated about 26% of total energy input.

The main reason of this is, not only the loss of high temperature energy potential of the exhaust gases but also the energy potential of very high temperature flame and flames radiation potential. In this type of heating systems, the flame is wanted to be kept inside the heating zone because of its very high temperature, which is useful for convection and radiation. It is desired to finish the burning of natural gas inside the heating zone, but never outside. Because of this, the opening losses had a high percentage through the total energy input. Hot surface radiation losses were calculated with Eq. 7. The mean temperatures of surfaces of the NGF were achieved via thermal camera (See Figure 3). In the system, the insulations were also not optimum. At some points on the furnace, the wall temperature was reached to 200 oC.

This wall temperature is definitely not allowable temperature, because it means we are using the wall as a resistant heater to heat environment. Comparing to opening losses, hot surface losses are not seem to be serious. Nevertheless, the wall temperature should still reduced to To+40 oC.in Table 7. The exhaust losses were obtained via Eq. 5. It was considered that all the 1300 oC hot stack gases were lost with their energy potential, since the NGF system has no exhaust, recuperator or regenerator. In the system, even some of the flame was thrown out from the openings of the furnace. In most of the applications, the opening losses obtained 5% of the total energy input. However, in this study it was calculated about 26% of total energy input. The main reason of this is, not only the loss of high temperature energy potential of the exhaust gases but also the energy potential of very high temperature flame and flames radiation potential. In this type of heating systems, the flame is wanted to be kept inside the heating zone because of its very high temperature, which is useful for convection and radiation. It is desired to finish the burning of natural gas inside the heating zone, but never outside. Because of this, the opening losses had a high percentage through the total energy input.

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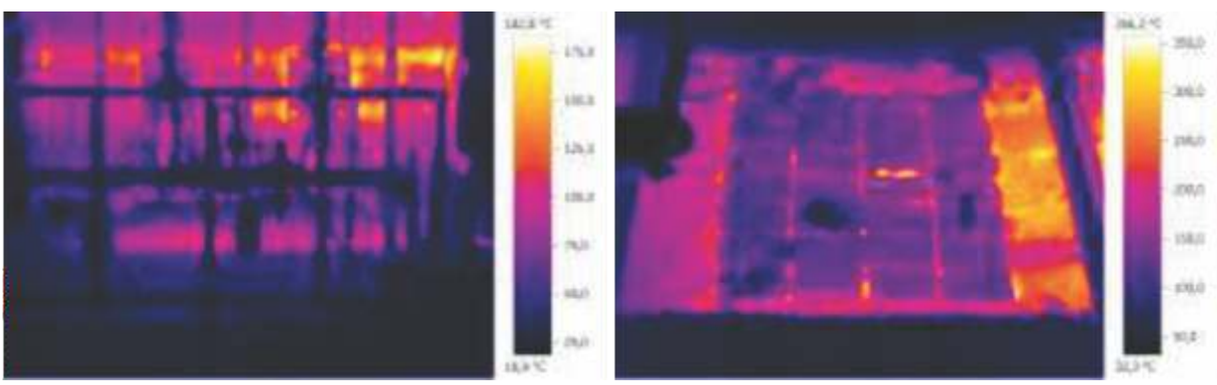


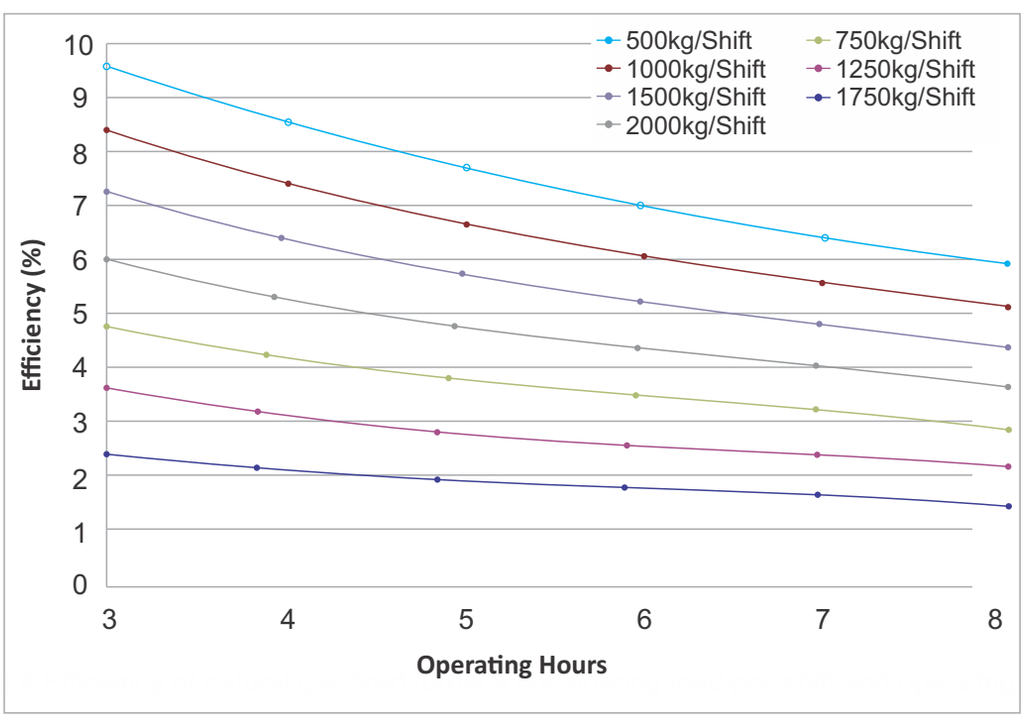
Natural convection losses were calculated with Eq. 8, which is given by Tütünoğlu (8). At first glance, the natural convection may not seem to be high in proportion to other losses. However, if the dimensions of the furnace are considered, we can conclude that it has to be reduced also. The high wall temperature causes high natural convection losses as well as radiation losses.

Finally, the efficiency of both induction and NGF systems were calculated via Eq. (9). The data were collected from meters for natural gas and electric. It must be noted that, the NGF system starts up 3 hours before shifts. Because of this, additional operating hours of combustion system were considered. However, the effect of combustion to attain steady state is various. It depends on many parameters such as, the difficulty level of the work piece, operating time, production quantity, diameter of the work piece etc.

Table 8 Validation of Analysis and Comparison

	Induction Ref (4)	Induction Ref (5)	Induction Analyzed	NGF Analyzed
Total Consumption (kWh/ton)	375	441	755	527
Energy Requirement (Kwh)	188	188	299	30
Losses (kW)	187	253	361	722
Efficiency %	50,23	42,72	52,19	5,74
Heating Cost ($/ton)	52,08	61,24	69,91	158,94

In table 8 validation of the analysis results and comparison of the subject furnaces of this study were given. In the analysis the result obtained from the induction furnace is in a good agreement with (4 and 5). Mainly efficiency agrees with the literature. A slight difference may cause from Cos ϕ of the systems, but NGF system has a dramatic difference between induction furnace as well as the other natural gas fired furnaces given in literature. The most important and basic reason is; the analyzed heating system has no exhaust. If there were, we could have a chance to measure the combustion and recover the waste energy. The efficiency, which is given in Table 8, is the mean value of calculation results. A detailed analysis of efficiency of NFG is given in Figure 4. As it is mentioned, the efficiency of NGF depends on many parameters. If the order can be produced in 3 hours then the efficiency differs between 2,4,9,5% as to the production mass in one shift. If the mass of the production in one shift increases, efficiency of the system also increases. Let's consider that 500 kg will be forged, when it is forged in 3 hours the efficiency of the system calculated 2,4%. However, when production time extends to 8 hours, the efficiency of the system decreases to 1,5 %.



The efficiencies given in figure 4 are all very low. The system is old and ineffective. Because of this, a project proposal was given to East Marmara Development Agency (MARKA) to develop the NGF system and it is accepted. In the scope of the project, the system replacement of the old system with a modern NGF system was proposed. Taking into account that the most efficiency detractive topics are exhaust losses and opening losses, the projected system will have regenerators and economizers, tight lids. Since the most energy destructing section of the existing NGF are lids, to avoid the opening losses and leakage of the flame, a useful lid system is designed. In the designed NGF, loading system will minimize the load/unload losses as well as leakage. The wall insulation is considered to stabilize the wall temperature at (To+40) oC, so the radiation and natural convection losses will also decrease. With the projected NGF, efficiency is supposed to increase up to 40%.

It is also decided that the next project will be about hybrid system that heat the workpiece up to 900 oC by NGF and to 1300 oC by induction furnace.

CONCLUSION

In this study, a thermodynamic analysis has performed for two types of furnaces of a forging facility as well as recent studies. The data are collected from an induction furnace and a natural gas fired furnace. It is seen that the efficiency of induction furnace is about 52%, which agrees with the literature. However, the NGF is very ineffective since the losses of the system are very high. Depending on the lot size and operating hours, the NGF efficiency was calculated max. 9.5% and minimum 1.4%. It is identified that the highest energy losses are exhaust (162 kW) and opening losses (140 kW) in order. In the current situation, heating the material with induction furnace is clearly profitable. Finally, the inefficient NGF should be remade with current technology.

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ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS IN FORGING

Vishwas Kale, Managing Director
Vijayesh Instruments, Pune

AI and Human Intelligence

Artificial Intelligence (AI) could be defined as the simulation of human intelligence in machines programmed to think like humans and mimic human's actions. This term may also be applied to a machine that exhibits traits associated with a human minds or brain such as learning and problem solving skills. A very high cost and time was associated with analysis and prevention of defects in forgings because previously dependency was on the conventional trial and error methods that lead to huge losses.

Forging after forging, large volumes of information is generated, which are not being exploited. With AI, this information is stored, and then processed through different statistical and ML methods, obtaining useful information to make decisions in materials' chemistries, optimal scheduling of forgings, and even of all the work carried out on the production work like process planning heat treatments, analysis, defect identification, packing etc.
AI and ML tools and strategies can help unlock their value in many ways. Depending on specific issues, solutions can fall into several categories, including:

- **Descriptive:** What happened?
- **Diagnostic:** Why did it happen?
- **Predictive:** What will happen?
- **Prescriptive:** What is the optimal business decision?

One Example

Forgings and Heat treatment

The material is heated in a furnace, but the material is sensitive to temperature changes. If the material becomes too hot or cold, it must be discarded and replaced, which costs both energy and materials but also production time. Many furnaces are controlled manually, and the temperature is completely dependent on the operator. However, AI could potentially be used to automatically regulate the temperature of the furnace. A prototype of an AI-based system for process control is created that can control and automatically regulate the temperature to optimize the quality of the component. This will result in a large reduction of scrap, which in turn will significantly decrease the energy consumption and environmental impact. Data is collected from forging production line and based on it, an algorithm is been developed and tested in a simulator. The simulator runs real-life scenarios that may occur during the manufacturing process, such as production stops, from which the AI algorithm learns. When the algorithm maintains the correct temperature range regardless of the situation, it is used in actual production line.

Some areas where AI and ML give help are:

- **Defects:** These are sometimes unavoidable and extremely costly in manufacturing. Sometimes the average manufacturing company has a cost of poor quality at sizable percentage of total sales. AI automates defect detection with unparalleled accuracy to minimize delays by catching issues as they arise. It gives immediate alerts to avoid slowdowns and increase ROI
- **Safety:** Manufacturing jobs have the highest rate of workplace injuries resulting in lost revenue. Complex machinery with moving parts, sharp edges, and hot surfaces makes them inherently dangerous. AI monitors hazardous areas, track personal protective equipment compliance, and helps to manage in a better way machine usage in real-time. It gives immediate alerts
- **Lead scoring:** Based on behaviours and demographics, AI can predict the likelihood that a sales opportunity will convert and also identify next best actions given the stage in the buyer journey and customer characteristics.
- **AI demand modelling:** AI can generate a time series forecast of demand not simply based on past sales but also based on millions of external economic, demographic and industry-relevant data sources.
- **Provide valuable insights:** Integrated digital solutions with tax artificial intelligence and machine learning capabilities can streamline tax functions that mitigate risk and provide valuable insights related to income, cash flow, costs and other variables.

Data analytics

Data analytics enables organizations to analyze all their data (real-time, historical, unstructured, structured, and qualitative) to identify patterns and generate insights to form and, in some cases, automate decisions, connecting intelligence and action.

How to Use Data Analytics: The process-understand the business problem

- Collect and identify data relevant to the problem.
- Prep the data for analysis.
- Analyze the data to generate insights.
- Deploy/operationalize analytics and models.
- Monitor and optimize performance.

The Benefits of Data Analytics

- **Simplify, Collaborate, and Do More**
  Today's top data analytics solutions simplify what used to be a very complex process. Collaborating across data science, line of business, and IT teams on big data analytics projects increases efficiency and productivity for the entire organization.

- **Find Anomalies and Take Action**
  Analyzing high-volume streaming data both within your core business systems and at the edge allows you to find anomalies, make decisions, and take action at the point of impact.

- **Operationalize, Monitor, Manage, and Trust**
  Many organizations struggle to operationalize analytics. As data drifts and models decay, being able to retain, refresh, and automatically deploy new analytic models at the edge, or directly within core business systems, lets you understand and act on trustworthy results.
- **Connect Intelligence to Action**
  With full visibility into all data anywhere, your organization can make the best decisions based on real-time, actionable insights and intelligence. Improve business outcomes by infusing analytics into the business and automating decisions.
- **Respond Fast and Correctly**
  Respond to events in a fraction of a second and ensure the right people take the right actions at the right time to get issues corrected quickly.

The Impact of Data Analytics

Data analytics, when harnessed correctly, can be a source of competitive advantage. Organizations that approach data analytics with a focused vision can drive digital transformation, improve customer experience, and create a data-driven company culture. Using data analytics, organizations can identify new business opportunities and use insights to prioritize actions and create new sources of revenue. To capitalize on the value data analytics can provide to an organization, companies must consider data for every business decision as a way to optimize outcomes and drive more informed decision-making. For prosperity do go in earnestly for these technologies.

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Industry Reports

1. Auto sector to post healthy revenue, PAT growth driven by volumes, favourable mix, operating leverage

India Metal Forging Market Competition 2023

India Metal Forging market currently, in 2023, has witnessed an HHI of 2550, Which has decreased slightly as compared to the HHI of 2976 in 2017. The market is moving towards concentrated. Herfindahl index measures the competitiveness of exporting countries.
Automobile companies are expected to report decent earnings growth during the first quarter of FY25 led by robust demand momentum. While auto sector Q1 results may see strong revenue growth, operating performance is also expected to improve on the back of a favourable product mix and operating leverage.

Auto demand in the quarter ended June 2024 remained strong. Auto OEMs (Original Equipment Manufacturers) reported volume growth of around 10% year-on-year (YoY) in Q1FY25, with broad-based growth in almost all the segments.

Two-wheeler segment outperformed with 11% YoY growth, followed by Passenger Vehicles (PVs) with 6% YoY growth. Commercial Vehicles (CV) and tractors grew by 4% each during the April-June quarter.

Brokerage firm Motilal Oswal Financial Services expects a volume CAGR of 9%, 6% and 5% for two-wheelers, PVs and Tractors over FY24-26. For three-wheelers and CVs, it anticipates a volume CAGR of 8% and 7% over the same period.

Revenue, EBITDA and net profit for auto companies under MOFSL coverage universe is expected to grow 9%, 14% and 18% YoY during the quarter. EBITDA margin for our Auto OEM universe (excluding JLR) is expected to improve 170 bps YoY at 13.1%, driven by moderate commodity costs on YoY basis, a favorable product mix and operating leverage.

2. Market Forecast By Raw Material (Carbon Steel, Alloy Steel, Aluminum, Magnesium, Stainless Steel, Titanium, Others), By Applications (Automotive, Aerospace, Oil & Gas, Construction, Agriculture, Others) And Competitive Landscape

The range lies from 0 to 10000, where a lower index number represents a larger number of players or exporting countries in the market while a large index number means fewer numbers of players or countries exporting in the market.

India Export Potential Assessment For Metal Forging Market (Values in USD Thousand)

For India Exporters of Metal Forging, Singapore seems to be the most attractive market (in 2028) in terms of export potential followed by Netherlands, Myanmar, Germany and Belgium.

However, in terms of total import demand across all countries, Germany occupies the top position. Hence considering overall import demand, Germany leads the importing demand but considering India as a partner, Singapore provide high unmet demand potential as Compared to others for 2028.

India Metal Forging Market Synopsis

The India metal forging market is expected to witness a CAGR of around 13.1% during the forecast period 2020-2026. Metal forging involves shaping and forming of different metals into desired shapes using high pressure compressive forces. In India, there are several large scale manufacturing companies that produce an extensive range of products related to metal forging such as automotive components, hand tools, fasteners & specialty components for industrial applications. The growth in demand for forged parts from different end-use industries such as construction, automotive and aerospace has been driving the India metal forging market over the past few years.

Drivers of the Market

The primary factor driving the growth of India metal forging market is the increasing demand for production efficiency across various industries. This has resulted in manufacturers opting for cost effective and reliable forged parts instead of machined or casted parts due to their enhanced strength resulting in fewer replacements and repairs with time which helps reduce overall costs associated with maintenance activities significantly. Additionally, due to global advancements in technology and robust R&D initiatives undertaken by key players operating in this space have led to massive improvements in design complexity when it comes to manufacturing process making use of semi automated machines thereby reducing human labor improving accuracy while simultaneously increasing output rate significantly helping these entities optimize operational efficiencies further boosting revenue potential eventually leading towards higher profitability margins aiding industry expansion going forward.

Challenges of the Market

The main challenge faced by many Indian companies involved with metal forging operations is lack of skilled labor particularly knowledgeable about advanced technologies which can bring together formability & weldability along with strength required typically from forgings leading towards development of more efficient machinery & equipment designs capable enough overcoming problems associated previously observed during operation cycles

Trends of the Market

One major trend witnessed amongst key players within this domain involve adoption 3D printing technologies coupled with rapid prototyping capabilities allowing them manufacture intricate geometries effortlessly maximizing product performance efficacy substantially enabling operators obtain desired outcomes at reduced costs eventually paving way for higher profit margins encouraging further investments into respective verticals.

3. Forging Market

Segments - by Type (Impression die forging, Cold forging, Open die forging, Seamless rolled ring forging), by Metals/Raw Materials (Aluminium, Magnesium, Copper/Brass/Bronze, Microalloy, Special steel alloy, Carbon and Stainless Steel, Nickel based, Titanium, Refractory metals, Zirconium) by Application (Automotive [Light Commercial Vehicles, Medium & Heavy Commercial Vehicles], Aerospace, Oil & Gas, Agriculture, Mining, Construction, Power Generation, Machinery, Hydraulic & other Machinery, Ordnance, Others), and by Regions (North America, Latin America, Europe, Asia Pacific, and Middle East & Africa) - Global Industry Analysis, Growth, Share, Size, Trends, and Forecast 2023 – 2031

The global forging market was valued at USD 81.72 Billion in 2022 and is projected to reach USD 124.62 Billion by 2031, expanding at a CAGR of 4.8% during the forecast period 2023-2031. The demand for forged parts is growing with the rise in activities across the medical and pharmaceutical field around the globe.

Market Dynamics

The demand for forged metal parts is rising with the growing commercial and passenger vehicles industry around the globe. Cars and trucks use approximately 250 forged parts. Forged parts are preferred in the manufacturing of vehicles, as they are more durable and stronger than the parts molded using alternative techniques. The use of forged parts in the growing automotive industry, thus driving the forging market.

The nuclear power industry uses forged metal parts for rectors, nuclear waste storage, and raw material & waste transport. Forged parts are used for manufacturing of pressure vessels. Many machines in the nuclear power industry use forged components, as they are put under high temperature and pressure. This, in turn, is driving the forging market. Rise in the use of nuclear power instead of conventional power sources is driving the forging market. The forging process has certain limitations regarding design, size, and martial that is being forged. Components with complex designs cannot be formed using forging. The forging process uses compression to form the components, which are not ideal for complex shapes. The forging process has size limitations. Parts of a certain size and shape can be forged as a press is used for forging. Brittle metals cannot withstand the pressure applied in forging process. Moreover, high initial investment for forging and additional costs of secondary fishing restraining the forging market.

Segmental Outlook

Increasing number of automotive, aircraft manufacturing units also the rising construction activities has boosted the demand for forged parts. Asia Pacific region to witness substantial growth during forecast period in terms of demand for forged parts. The boom in automotive and construction industry owing to the rapidly growing population in the region is prime factor driving the market growth.

On the basis of type, the global forging market is segmented into impression die forging, cold forging, open die forging, and seamless rolled ring forging. The impression die forging segment held a substantial share of the market in 2019, and is anticipated to expand at significant CAGR during the forecast period.

Impression die forging, also known as closed die forging, is widely used, as it can produce complex designs. The number of dyes required for closed die or impression die forging depends on the complexity of the design.

On the basis of metals/raw materials, the global forging market is segregated into aluminium, magnesium, copper / brass / bronze, microalloy, special steel alloy, carbon and stainless steel, nickel based, titanium, refractory metals, zirconium. The carbon and stainless-steel segment held a substantial share of the market in 2019, and is anticipated to expand at significant CAGR during the forecast period. Carbon and stainless steel is known for its strength and corrosion free properties. These metals are used for applications such as kitchen equipment and equipment related to food services.

On the basis of applications, the global forging market is divided into automotive and others. The automotive segment is further divided into light commercial vehicles (LCVs) and medium & heavy commercial vehicles (MHVs). The others segment includes aerospace, oil & gas, agriculture, mining, construction, power generation, machinery, hydraulic & other machinery, ordnance, and others.

The automotive segment held a substantial share of the market in 2019. Moreover, the medium & heavy commercial vehicles sub-segment held a key share of the segment. The medium & heavy commercial vehicles segment is anticipated to expand at a significant CAGR during the forecast period.

Regional Outlook

In terms of regions, the global Forging market is segregated into North America, Europe, Asia Pacific, Middle East & Africa, and Latin America. Asia Pacific is expected to remain an attractive region of the market due to growing technological advancements in automobile and other industries in the region.

The market in Asia Pacific is projected to grow due to significant growth in the number of automobile industry in the region. Moreover, growing agriculture and hydraulic machinery industries are expected to boost the forging market in the region. The market in North America is expected to grow at a substantial pace due to rising ordnance and automobile industry in the region. Furthermore, Europe is expected to hold a significant share of the market during the forecast period.

4. How India is emerging as an advanced energy superpower

India is emerging as a global powerhouse in advanced energy solutions. It is the largest country in the world by population and fifth by size of national economy. It is also the third largest in terms of carbon emissions. According to Jennifer Granholm, US Secretary of Energy, “In so many ways, the world's energy future will depend on India's energy future.”

In line with this, the country is adopting ambitious goals for deploying solutions such as clean hydrogen, energy storage, carbon capture and sustainable aviation fuels.

Based on announced pledges, India is expected to invest more than $35 billion annually across advanced energy solutions by 2030 (excluding any solar or wind investment). Investment in battery storage alone must reach $9-10 billion annually.

Fast renewable growth drives exponential demand growth for energy storage in India. The country intends to build 47 gigawatts (GW)/236 GW hours (GWh) of battery storage capacity by 2031-32. This ambitious scale-up is equivalent to installing nearly 80 of the largest battery storage facilities globally and 110 times larger than the capacity of India's battery energy storage systems.
In clean hydrogen, India has set a target to achieve a production capacity of 5 million metric tonnes (MMT) by 2030. The country aims to build an electrolyzer manufacturing capacity equal to 40GW by 2030 to achieve this goal. This will more than double the total global existing manufacturing capacity at the end of 2023.

More attention has been paid to energy storage and green hydrogen due to the country's techno-commercial maturity and demand requirements. However, India's ambitions and needs go further. By 2030, India aims to achieve 30 MMT capacity of carbon capture and storage and 2 MMT of sustainable aviation fuels from currently negligible levels.

AIFI – MEMBERS NEWS/ACHIVEMENT

MM Forgings' arm Abhinava Rizel to launch hybrid EV motors

Ramesh M
Chennai

Chennai-based Abhinava Rizel Ltd, a subsidiary of MM Forgings Ltd, is set to begin manufacturing import-substituting, hybrid motors for electric vehicles next month.

The company will start with motors for passenger and cargo 3-wheelers, for which it has orders, but it also has products ready for passenger cars.

Abhinava will produce motors combining permanent magnet and 'reluctance' motors. These motors combine two functionalities that are almost mutually exclusive — high torque and high rpm.

In 2016, three friends – Shivam Bhatia, BVN Madhu and Karthik Donthula – who had just completed their engineering degrees at the SRM Institute of Science and Technology in Chennai decided to join hands and produce a motor with high torque and high speed. They formed the start-up Abhinava Rizel in May 2022. Their idea was to hybridize permanent magnet motors with reluctance motors. Reluctance is a torque force that helps the rotor align for easier magnetic field flow. Although reluctance motors were deemed inefficient a century ago, they are now returning for electric vehicles due to the steady battery power supply. Reducing the size of the permanent magnet in the motor also cuts costs and weight, as these magnets are heavy and imported.

In a few years, the team designed the wonder motor. In September 2022 the ₹1,500-crore, Chennai-based auto components manufacturer, MM Forgings bought into the idea, putting in ₹15.84 crore for an 88 per cent stake in Abhinava Rizel.

MAN & THE MACHINE. Shivam Bhatia with the EV 3-W motor which Abhinava Rizel will soon start manufacturing

It has since given the subsidiary a loan of ₹15.21 crore. MM Forgings is expected to bring ₹200 crore into Abhinava Rizel.

Abhinava says that for their products, it is practically a blue ocean out there. "Up to 10kW, there are many players, but above 10kW, the game changes from volume to technology," Bhatia told *businessline*.

The start-up has products up to 100 kW. (The 100 kW motor, incidentally, boasts of 12,000 rpm, torque of 250 Newton-metres, peak efficiency of 96 per cent, drive cycle efficiency of 92 per cent and weighs 29 kgs.)

A recent report by the consultants Frost & Sullivan says that the number of electric passenger cars in India will increase to anywhere between 700,000 and a million by 2030, from (an estimated) 123,000 in 2024-25.

R&D FOCUS

While about ₹85 crore of the funds from MM Forgings have been used to set up the manufacturing facility, Abhinava Rizel is also spending heavily on R&D.

Bhatia said that the R&D team's strength is to be raised from 60 today to about 100. "We are aggressively investing in R&D," he said, adding that the company had spent $5 million on equipment for in-house validation of its products.

Super Auto Forge to pump ₹500 cr in capacity expansion, tech

G Balachandar
Chennai

Super Auto Forge Pvt Ltd, a Tier-2 auto component supplier, plans to invest ₹500 crore over the next five years in capacity expansion and technology upgrades, driven by a positive growth outlook in both export and domestic markets.

After completing an ₹350-crore expansion in March, the company plans further investments to enhance its cold, warm and aluminium forging lines.

"We have 90 per cent visibility of our order book for the next two years and 70 per cent for the next four years, as we engage with customers well in advance," said S Seetharaman, Chairman of Super Auto Forge, during an interaction.

Buoyed by a strong order book and promising prospects for new orders, the Chennai-headquartered manufacturer of cold-forged steel and aluminium parts anticipates nearly doubling its revenue in the next five years.

(from left) S Ravishankar, Joint MD; S Seetharaman, Chairman and S Muralishankar, MD, Super Auto Forge

"We ended FY24 with a topline of ₹15,80 crore and are hopeful of reaching ₹2,000 crore by the next fiscal year. We may achieve ₹3,000 crore revenue milestone by FY29," Seetharaman added. Celebrating its Golden Jubilee this year, the company derives about 80 per cent of its revenue from export markets. Although domestic opportunities are gradually increasing, Super Auto Forge focuses continues to focus on export markets for medium-term growth.

EXPORT FOCUS

"There is no major competition for us in this space. There are a few players who can handle small volumes, but there is hardly anyone who can produce about 3 lakh parts a day with consistent quality and timely delivery," he said.

S Muralishankar, Managing Director, explained that the company has also pursued forward integration to remain competitive. "Previously, we were doing only forging. Now, we produce ready-to-assemble parts in large quantities, including critical parts previously made by Tier 1 suppliers, who now take our parts, assemble them, and supply them to OEMs. This puts us ahead of our competitors. Additionally, we are the single source for about 90 per cent of the parts we make," he added.

The company attributes its edge in forging technology to its strong in-house capabilities built over the years, with about 40 people currently employed in R&D.

S Ravishankar, Joint Managing Director, mentioned that the company is benefiting from China Plus One strategy of global auto OEMs. New opportunities are also emerging from the European market due to rising energy and manpower costs for manufacturers.

In the domestic market, the company is aggressively pursuing opportunities in the defence sector, driven by favourable offset policies and an export focus.

"Our strong export capabilities will help us serve emerging domestic opportunities. For instance, we are a leading player in aluminium forgings. When the aluminium business grows in India, we will have more edge," added Ravishankar.

AIFI – ACTIVITIES AT A GLANCE

New Initiatives
· Working on to reach out each Forging hubs in India to expand membership
· Working on finding experts in each region to organize training programmes in each Forging hub
· Circulation of Key Press Reports on Industry and Govt. Policies (Fortnightly)
· Post Budget discussion to get a crisp summary on Budget Proposals
· Working on formation of "**AIFI - GenNext Entrepreneurs Forum".**
· HR Forum

Month	Activities Held	Remarks
April		
15th April 2024	Northern Region Meeting	In Person- Delhi
26th April 2024	Western Region Meeting	In Person- Pune
29th April 2024	Training program on 43B(h) clause of Income Tax Act	Online
May		
31st May	Western Region Meeting	In-person, Pune
June		
8th June	Southern Region Meeting	In-person, Chennai
25th, 26th and 27th June	Training Program on "MS Excel for Business"	Online
25th June 2024	Tree Plantation Drive	In person- Pune
28th June 2024	Western Region Meeting	In person- Pune
July		
24th July	Training Programme on "Minimize Operational Challenges in Forgingand Increase Profitability"	In-person, Ludhiana
24th July	Northern Region Meeting	In-Person, Ludhiana
26th July	Post Budget discussion to get a crisp summary on Budget Proposals	Online
26th July	Western Region Meeting	Online
August		
6,7 & 8th August 2024	Training Programme on "Finance for Non-Finance"	Online

9th August 2024	Training Programme on "Minimize Operational Challenges in Forging and Increase Profitability"	In-person, Pune
23rd August 2024	Knowledge Sharing Session on " Building Customer Centricity"	Online
30th August 2024	Western Region Meeting	In Person, Pune
	Forthcoming Activities	
September		
27th Sept 2024	Special Session on "Innovative Technology Solutions and Skill Development	In Person, Pune
Sept 2024	Southern Region Meeting	In-person, Chennai
Sept 2024	Improve Operational efficiencies in Forging industry leading to customer delight	In-person, Chennai

International Events

Month	Events Held	Remarks
July		
4-7 July 2024	MetalForm China 2024	Shanghai, China
	Forthcoming Events	
September		
4-5 September	FORJAMEX 2024	Queretaro, Mexico
17-18 Sept 2024	33rd Forging Industry Technical Conference	Erie, PA
October		
22-24th Oct 2024	EUROFORGE conFAIR 2024	Milan, Italy
November		
25-28 November 2024	8th Asiaforge Meeting	Wuhan, China

AIFI Southern Region meeting held on 8th June 2024 at Hablis Hotel, Chennai

AIFI Western Region Meeting, held on June 28th, 2024, at Hotel Parc Estique, Pune

Training program on "Minimize Operational Challenges in Forging and Increase profitability" Held in Ludhiana on 24th July 2024 and pune on 9th August 2024.

AIFI Conducted Tree plantation drive in Pune on 25th June 2024.
285 Samplings provided to 9 companies.

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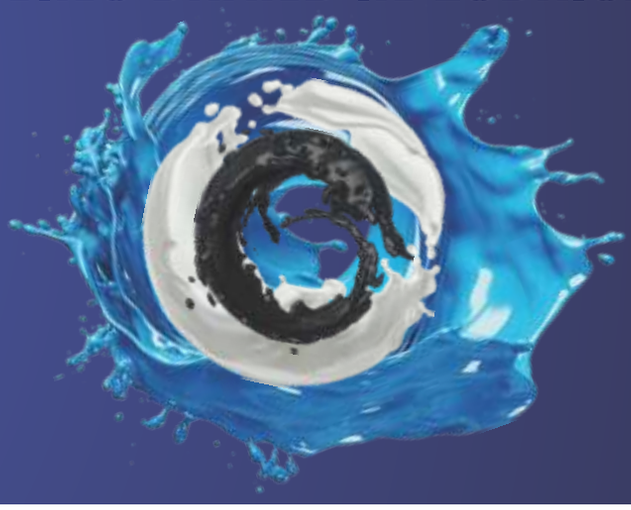

DIE LUBRICANTS

FORGING

- Pre- Forge / Pre -HT Coatings
- Specialty Non - Ferrous Forging Lubricants
- Cold Forging Lubricants / Coatings
- Oil Based Extrusion Lubricants
- Fuel Additives
- Graphite Based Die Lubricants
- Non - Graphite Die Lubricants
- Spray Guns
- Spraying Tank
- Lube Auto-Mixing Units

CASTING

- HPDC Die Coats
- LPDC Die Coats
- GDC Die Coats
- Plunger Lubes
- Plunger Tips
- Laddle Coats

SPECIALITY LUBES

INDUSTRIAL GRADE

- Chuck Paste
- Compressor Oils
- Greases
- High Temp .
- Chain Lubricants

FOOD GRADE

- High Temp. Chain Lubricants
- Food Grade Greases

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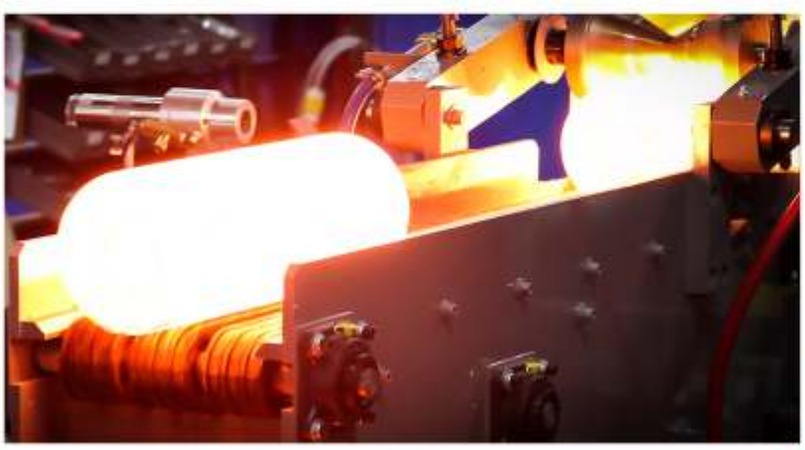

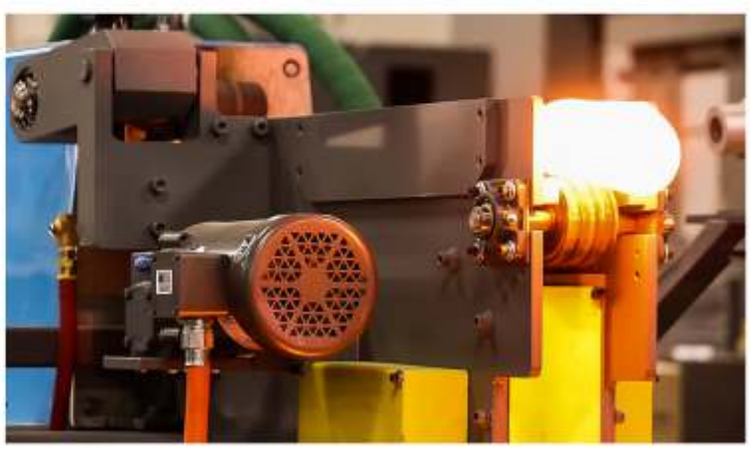

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Important: Appropriate Personal Protective Equipment (PPE) must be worn by anyone in proximity to molten metal.