International Journal of Engineering Sciences & Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

REVIEW PAPER ON PERFORMANCE ENHANCMENT OF FOUNDRY INDUSTRY BY ENERGY CONSRVATION ANALYSIS

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DOI: https://doi.org/10.29121/ijesrt.v9.i11.2020.7

ABSTRACT

Micro, Small and Medium Enterprises (MSMEs) have been accepted as engines of economic growth to promote and accelerate equitable development worldwide. The major advantage of this sector is its enormous employment potential which constitutes around 90% at significantly low capital involvement. In recent years the sector has consistently registered higher growth rate as compared to the overall industrial sector. With its agility and dynamism, the sector has shown admirable innovativeness and adaptability to survive the recent economic downturn and recession. However, despite the significant contributions made towards various aspects of the nation's socio-economic scenario, this sector too faces several critical issues that require immediate attention. One such factor that falls under this text is the prevalence of age old technologies across the sectors and inherent inefficiencies associated with resource and energy utilization. As a result of increasing awareness towards efficient usage of energy and other resources, there has been a visible reduction in energy intensity but still studies conducted on the MSME sector reveal that the energy intensity per unit of production is much higher than that of the organized large scale sector. Most foundry units which are highly energy intensive fall under MSME category in India. India produces 12.24% of global casting at present. If energy intensity per unit production of MSME is to be brought closer to that of organized large scale sectors then energy conservation is the only way that can do so with efficient use of energy and steep rejection of energy wastage without suppression of demand for energy use.

KEYWORDS: MSME, Foundry Industry, Energy Conservation.

1. INTRODUCTION

The Indian foundry sector contributes 17% to gross domestic product (GDP). The Indian foundry industry is poised for dramatic growth in the coming decades following geopolitical shake-up like China being under stress and foundry capacities not coming up in western nations due to pollution concerns. This has fuelled increase in demand for castings produced in India and are expected to continue in coming years. Hence foundry plants have better prospects available for enhancing performance and productivity and no doubt energy conservation will play vital role in this. Energy is an indispensable component of industrial product, economic growth and comfort. The gap between supply and demand of energy can be bridged with the help of energy conservation which is cost effective approach at the same time has shorter payback period with modest investment. There is a good scope of energy conservation in an energy intensive sector like foundry industry where even a small saving can enhance profitability to a great extend.

The process layout of foundry to produce desired casting is represented below in figure1. It can be divided into five major operations namely: sand preparation, pattern making, core making, melting, pouring, fettling and inspection after which final product is available to consumer in either unassembled or assembled form. The foundry industry needs considerable amount of energy to carry out these operations effectively almost half of which gets consumed for melting process.

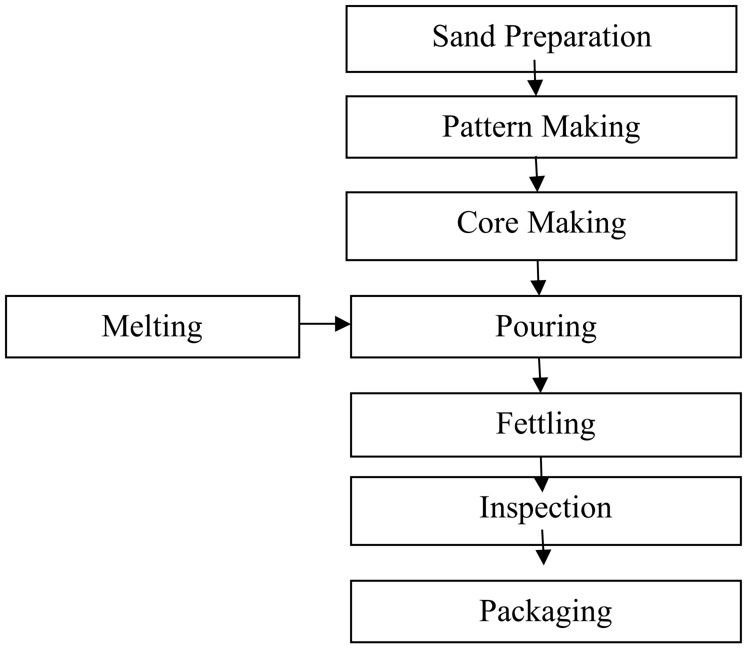

FIGURE: 1

2. LITERATURE REVIEW

Various researchers have worked on energy conservation analysis and management practices in foundry. These studies are motivated by the fact that energy conservation and efficiency improvement in the foundry industries requires special attention since the sector has been suffering from a chronic energy supply shortage, lack of capital investment for new capacity addition and modification; also environmental problems.

Anupama Gupta, Pallavi Verma, Richa Priyadarshani [1]**,** have underlined importance of energy conservation and talked about its need, who should be part of audit team, factors to be considered prior to it, its types along with steps to be followed. They also suggest use of AC electronic variable speed drive instead of a start delta starter and pulley arrangement for a 3 –phase AC induction motor for fume exhaust system blower in cold rolling mill. They found that this approach saves 90,000 kWh a year with a payback period of 5 months along with increase in life of motor and mechanical components due to smooth start.

Salini M Venugopal, Ahamed Shahas S, Amal George, Arjun P D, Mohammed Yaseen P K, Nelson J [2]**,** carried out study in Kavanar Latex Ltd. Authors noted that replacing existing equipments if under loaded on basis of loading pattern can lower energy consumption. While in case of lighting load, replacing CFL with lower wattage LED almost halves the energy consumption and provides better illumination.

Malkiat Singh, Gurpreet Singh, Harmandeep Singh [3]**,** performed analysis of halogen lamps, florescent tubes and mercury vapor lamps. They noted that consumption and cost of power for florescent tube with electronics choke is 35% and 30% less compared to florescent tube with copper choke with payback period of 8 months; for metal halide lamp it is 50% and 200% less compared to halogen lamp with payback period of 4 months; and for LED lamp it is 450% and 550% less compared to conventional indicating lamp with payback period of 4 months. Hence they suggest replacing florescent tubes with copper chokes, halogen lamp with florescent tubes with electronics chokes, metal halide lamp, LED lamp respectively in phased manner or after failure.

S. U. Kulkarni, Kalpana Patil [4], conducted electrical energy audit program at Loknayak J.P.Narayan Shtekari Sahakari Sootgirni under three major heads namely lighting, power load and harmonic analysis. In lightning audit use of electronics ballast in place of copper ballast was found to achieve 29% energy saving. Moreover use of reflectors in ring frame areas which are removed are found to enhance illumination level. In power audit use of fiberglass reinforced plastic as material for cooling fan was found to save 2% of rater KW of motor along with preventing material build up and pitting due to corrosion. When compared to aluminium fans it is 20 to 40% more efficient. In harmonic analysis, use of harmonic filter was found to be vital to bring down harmonic components under permissible limit. It was also noted that harmonic component across individual loads is much higher in case of variable frequency drives and this needs to be considered while designing harmonic filters.

Jijo Balakrishnan, AryaKrishnana. P, Joice Joy, Nibin K.N, Reshma Chandran, Sree Vishnu [5], have explored some of the options that energy auditor can consider while conducting an audit in an educational institute.

K.Dinesh, A.Stephan Kennedy, V.MayaPerumal, B.Jenison, D.Umeshwar [6], carried out electrical energy audit program at Kohler Power India, Aurangabad and calculated energy saving that can be achieved by replacing High Pressure Sodium Vapour lamp (HPSV) with Induction lamp for bay lighting.

Mr.Laxmikant Radkar, Mr. Ganesh Tope, Mr. Nikhil Wadkhelkar, Mr. Sushant Rampure, Mr. Y.P.Gawale [7], carried out study in Terminal Technologies (I) Pvt. Ltd., Pune and achieved 10% energy saving by implementing recommendations like VFDs, contract demand reduction and maximizing the power factor incentive with payback period of 6 months. It was also observed that energy saving with VFD's fitted in moulding machine reduced energy cost drastically at lower speeds.

Srabana Pramanik (Chaudhury), Tanmoy Chakraborty, Khairul Alam, Satadal Mal, Debabrata Sarddar [8], studied the role of air conditioning and lighting system in consumption of electricity of faculty room and suggested use of an efficient microcontroller based system which would turn on/off electrical appliances depending on occupants in room to reduce consumption of energy.

Khwaja Faiz Ahmad, Dr. A. G. Matani, Dr. S.K. Doifode [9], conducted dissertation work for indentifying opportunities and possibility of finding solutions to reduce energy wastage in one of the foundry plants located at MIDC Amravati. It was observed that even a small reduction in the energy consumption achieved by switching off machines and lights during lunch break, running motors only when required, closing down stand alone units if the main system can provide the desired output at lower cost at an energy intensive industry such as a foundry is highly appreciable.

Faraz Ahmad, Dr. R. K. Jain [10], elaborate about India's current energy scenario and number of obstacles like inhibiting attitudes, insufficient technical know-how, market distortions, capital shortage which hinder the rational use of energy in industries.

B. Chokkalingam, V. Raja, M. Dhineshkumar, M.Priya, R. Immanual [11], talk about redesigning feeding system of casting for reducing rejections in casting which would indirectly save energy which was consumed to produce it and the one that would be consumed for re melt. They observed improvement of casting yield from 56% to 72% with the effective yield increasing to 66.80% from 12.89%.

Pankaj Maurya, Dr. Gajanan Patange, Apurva Indrodia [12], conducted energy audit of melting unit in foundry when different qualities of raw materials are used. This evaluation covered three process parameters of the melting sector of foundry – viz. charge material, charging practice and radiation loss. It was found that foundry waste like runners, risers are best charge material but as these are low in quantity these can be compensated by procuring optimum cost dirt, dust and rust free scrap material. Moreover in case of charge material the cost and quality of raw material needs to be considered as some charge material might save ample melting cost and lower slag formation but might have higher procurement cost which would end up with overall no monetary gain.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Dr. Dhananjay B. Devi, Prof. N. N. Shinde [13], found that out of total power consumed in terms of units, 60 to 75% is utilized for melting processes. On a conservative scale, it is possible to save at least 25% of it by adoption of energy efficient technology. If upgrading present technical status is not feasible at least 10 to 20% energy can be saved by enhancing energy intensity & energy security by following better energy management and conservation techniques.

Gahanna Patange, Mohan Khond [14], observed that two thirds of the energy consumed in a foundry is used for metal melting and holding operation and considerable energy saving can be achieved by proper attention to this process with proper energy management.

Arasu M. [15], on basis of surveys concluded that melting technique in any furnace is important for survival of a foundry. Energy conservation in melting can be achieved by controlling melting techniques, and applying quick charging of raw material, appropriate power input, cut down of idling time, improvement of dust collecting efficiency etc.

Mukopadhayaya M.K. [16], mentioned that controlling rejections in castings in a foundry industry is vital from energy conservation point of view.

Dr.R.K. Jain [17], studied energy consumption pattern in ferrous foundries and investigated measures for energy conservation. The study deals with LDO fired rotary furnace on which author conducted a series of experimental investigations. It is self designed and developed, rotary furnaces, installed at foundry industry in Agra. It is concluded from this experimental work that for energy conservation in melting, optimal rotational speed of rotary furnace is 1.0 rpm. This furnace when operated at optimal speed, energy consumption and annual energy consumption has been found to be reduced by 8.43 % and 1.247×10^5 KWh respectively and melting time rate improved by 22.22%.

Aditya Sindhu, Aashish Bhaskar, Arbind Singh [18], suggested measures to be implemented in a thermal power plant located at Amravati for improvement in overall efficiency and energy conservation. This measures help to drive the cost of generation significantly lower and improving the overall economics of power generation. Some of the above suggested measures like fuel switching, use of vapour absorption machines for indoor cooling can also be implemented in foundries to achieve desirable output at higher level of efficiency and energy conservation as compared to existing setup.

Anjna N. Singh, **Jagrati Sharma [19],** state that energy efficiency and conservation may be viewed as a new source of energy, benign and clean, having little investment and short payback period. This approach can go a long way in bridging the gap between demand and supply of energy. Energy audits and other activities for energy conservation and efficiency should be carried on regular basis to enhance and utilize its potential.

Mr.Harpreet Kaur, Mrs. Kamaldeep Kaur [20], underlined the importance of energy conservation. Energy supply is now not considered a commodity but a service. In view of authors, India's strong economic performance of recent years requires continuing effort from the newly formed government to widen the ambit of economic reform. They further mention that though the government has given higher priority for the power development projects, the Indian power sector is struggling with formidable difficulties of meeting the heavy demands of electricity due to higher amount of power losses and energy thefts. Energy conservation is the only route that can get better mileage out of the available resources. The need is to consider the possibility of evolving an appropriate strategy for energy conservation measures in the country to achieve economical and environmental benefits. This paper is helpful to understand the importance of energy conservation.

Michael Whiteley, Dr. Richard Greenough, Dr. Graeme Stuart [21], underlined importance of thermal imaging in energy conservation by analyzing multiple energy consuming devices like compressor, heat treatment machine, gas ovens etc at facilities in diverse sectors.

ISSN: 2277-9655
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3. CONCLUSION

Following conclusions can be drawn from the literature review carried above

- In case of lighting load, replace existing florescent tubes with copper chokes, halogen lamp, high pressure sodium vapour lamp (HPSV), CFL with florescent tubes with electronics chokes, metal halide lamp, Induction lamp and LED lamp respectively in phased manner or after failure.
- Use electronics ballast in place of copper ballast.
- Use reflectors in ring frame areas which are removed to enhance illumination level.
- Use day light to maximum extend.
- Follow a maintenance schedule for lightning system.
- Study loading pattern of equipments and replace existing under loaded equipments on basis of loading pattern.
- Ensure that motors are always operated between 75 to 100% of full load.
- Use variable frequency drives instead of conventional drive where load varies drastically with time.
- Clean, lubricate and check motors for over-heating on regular basis.
- Use fiberglass reinforced plastic as material for cooling fan of motors, cooling towers.
- Switch off idle running machines and lights during lunch break.
- In case of compressors, close down stand alone units if the main system can provide the desired output at lower cost.
- Check air distribution system periodically for leakage.
- Use booster compressor for higher pressure instead of increasing pressure of entire system.
- Install fans at higher elevation in compressor room.
- Select pump which have Best Efficiency Point (BEP) closer to pump requirement.
- Ensure that Net Positive Suction Head (NPSH) is adequate.
- Avoid using highly throttled valves.
- Replace bearing, seal and check pipes for corrosion, concentration of particulates and pH value periodically.
- Use siphone effect for advantage.
- Use booster pump for smaller load and higher pressure.
- Use dirt, dust, sand, oil/grease and moisture free scrap as charge material for foundry.
- Weight and arrange raw material on melt floor before start of melting.
- Ensure that maximum size of charge is not more than one third of diameter of furnace crucible and its edges do not affect refractory.
- Do not charge furnace beyond the coil level.
- Use lid mechanism for furnace.
- Avoid slag build up especially at necks above coil level where agitation is less.
- Use flat head tool instead of rod for slag removal.
- Avoid un-necessary super heating of metal.
- Design plant layout in order to ensure that the distance travelled by molten metal and temperature drop is minimum.
- Avoid molten metal for pre-heating ladle.
- Ensure that lining thickness is optimum.
- Ensure that coil cement is smooth in straight line with thickness between 3-5 mm.
- Use harmonic filter to bring down harmonic components under permissible limit.
- Ensure power factor remains under permissible limit.
- Use electronic control system and energy management software to monitor use of energy.
- Reduce rejections in casting.

All these concluding remarks show that there is a good scope of energy conservation in foundry industry

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