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Abstract
Energy is a multiplying factor which allows man to translate various raw material and resources into useful items to meet the daily demands and necessities of human beings. Foundry technology involved casting from molten metal transferred into a mould and permitted to harden under varying conditions depending on the purpose. This paper reviews the foundry industry as an energy exhaustive industry, in the sense that it requires energy in various forms such as electrical, heat and mechanical to carry out various engineering processes to deliver the appropriate casting required. It also reviews the different methods are currently being employed to make the manufacturing process more efficient and each of them have led to an increase in energy demand. It is affirmed that the new methods involved in foundry and their energy management policy can led to more efficient energy consumption for casted product.

Keywords: Foundry, Energy, Energy Consumption, Efficient

1. Introduction
Since ancient time, man has continued to look for ways to convert raw materials into useful end products to enhance the standard of living, improve development and enhance the level of civilization [1-5]. This quest has seen us enhance through different level of ages; the stone age, Iron age, industrial age and to the age of information and technology which we currently in. Metals have been in existence since prehistoric time, they exist naturally as ores and man has derived various manufacturing methods to convert these ores to useful materials [6-8]. Metal casting is one of those methods, it involves the subjection of these metals to high temperature leading to their conversion to liquid form and pouring it into a prepared mould of the desired shape and allowing it to solidify under the condition specified by the manufacturer. This procedure occurs in the foundry workshop [9, 10]. Foundry technology became well practiced as the first foundry was established in 1479 at Moscow. It was called the Canon Shop. In the 14th and 15th century a rapid increase was observed in the development of foundries as metals such as bronze, iron and steel were developed. The first foundry in the united states was the Saugus Iron Works, which was later converted to the American Iron and Steel institute in 1642 [11-13]. Due to the continuous research and development, efficient methods have been developed to create stronger and more reliable casting. This improvement has also led to the improvement in the overall energy consumption for the entire process [13]. Energy is a multiplying factor which enhances man ability to convert raw materials into useful products to meet human demands. The foundry industry consumption of energy in the electrical form is increasing. This has also led to an increase in the overall cost of the creating a product. Hence energy consumption management has become a huge factor of consideration for foundries [14-16]. For this reason, a number of researches have been carried out to quantify the rate of energy consumption and identify various opportunities for efficient energy utilization and saving potential.

2. Energy Consumption in Foundry

The foundry industry is classified as a largely energy intensive industry, energy in its various forms such as electrical energy and heat energy is required for various stages in the overall production process. This had led to the requirement of energy accounting which is to be conducted during specific intervals to discover the areas energy is being consumed and the rate it is efficiently being used. It also highlights areas that have good energy saving potential to reduce the overall cost of production [5]. Specific Energy Consumption is the energy that is required for one ton of liquid metal that is produced. There has been diverse research both carried out and are ongoing to discover efficient methods to reduce this value to the barest minimum without reducing the standard and quality of the casted products. Methods such as the CRIMSON (Constrained Rapid Induction Melting Single Shot Up Casting) has been established to replace traditional casting methods for small batch production. This process reduced the energy consumption required for the tradition casting method by 23% [6]. Energy management is a tactic of optimizing energy utilization. It involves adjusting and the use of systems and new methods that will reduce the energy required per unit output thereby reducing the total cost of production of the casted product [7].

As technology has continued to improve diverse equipment has been developed to efficiently develop castings, reducing wastage and energy losses. There are no sole criteria that can be used to explain the whole energy that is used throughout the industry because they are in diverse forms. Some developing countries do not have access to these improved technologies and are still backwards in efficient production methods. They end up consuming large volume of energy and have no idea about proper energy consumption techniques.

No doubt, the proper management of energy is very important as it involves developing and implementing systems and various methods to efficiently produce castings so as to reduce the amount of energy required. An energy audit is a valid method used to carry out a systematic review concerning the rate of energy consumption. Discovering the pattern of energy consumption is an important part of the energy auditing process. Studying energy patterns enable us to comprehend the diverse ways energy is being used in the foundry workshop, it highlights areas of energy wastage and provides suggestions to control energy cost by addressing and implementing solutions to the certain areas which have been highlighted. [8] conducted a comprehensive study in South Africa on their metal casting industry, he discovered that there has been a reduction in the total number of foundries in their region by thirty-six percent (36%) since 2007. This is due to certain factors like the high degree of energy required to run the foundries and the inefficiency and inadequacy of the supply. There are currently about 170 foundries in operation with a total annual production estimated at 375,240 tons. The foundry industry has to devise methods to overcome the challenges created due to the increase in energy prices, shortage and disruption in electricity supply for the transmission and distribution companies. The increase in the electricity prices is discovered to be the greatest threat to the growth of this industry if not adequately resolved [9]; [8]. A research work was carried out on four foundries to discover their various energy consumption rate required for the production of one ton of liquid metal by [5]. It was discovered that most of the available energy is used up in the melting sections of the various foundries. The consumption rates of the four foundries were compared to the standard values used to implement deviation control methods. The results of his study were that the specific energy consumption was about 18% greater than the normal standard value. The specific oil consumption was above 50% greater than the standard normal of the rotary furnace. Due to the foundries low capacity utilization they all had increased energy cost per ton for the production of castings. [10], mentioned that the foundry industry is greatly energy intensive and produces tons of waste both as scraps which may be useful in order forms or are toxic to the environment. Various papers and research have been done and are still being conducted to suggest a number of methods that have potential to reduce the total consumption of energy in a foundry in whatever capacity possible. Most of these papers agree with the

point that energy consumption can be saved from modifications made to the melting and holding process stages. Some proposed methods include the use of higher technology furnaces, waste heat recovery and the use of preheating facilitations [11]; [12]; [13]. [14] stated that energy accounting is paramount to control how and the various areas energy is consumed and the level of efficiency at which they are consumed. They carried out research on energy conservation and methods of pollution reduction which is highly intertwined with the survival and growth of the foundry industry and it is also a key point that leads to sustainable progress. [15] concurred that the foundry industry naturally required large quantity of energy. Energy is consumed in various forms, of which electrical energy is the major form. Energy is also lost in heat form during the pouring stage and also during inefficient melting stage which can lead to substandard product and material loss and wastage. An investigation was done on aluminum foundries and it was exposed that there is significant potential for improvement in the melting process. Stack melters were proposed, they are a specialized reverberator furnace where the metal charge is preheated with the exhaust gas. They are good energy efficient alternatives [16]. In a study conducted by [17], they concluded that energy, labor and resources are the main operating expenses. Amongst these three, energy has the highest cost and saving potential. South African foundries were understudied to analyze various energy efficiency methods employed. The method used to carry out this study was an industrial energy audit. This estimated the energy utilization of the plant and areas where this energy can be optimized to avoid wastage [18]. [19] found out that small and medium enterprises in Uganda face a lot of challenges that slow down their growth rate and level of competitiveness and energy management improvement of their energy consumption can enhance their competitiveness, improve their overall growth rate and enhance production.

3. Energy Efficiency Opportunity in Foundries and Present States

There are numerous prospects in the foundry that have been found to have energy saving potential in areas like ventilation, lightening and compressed air. A study carried out on Canadian foundries showed that the highest energy saving potential lies in the fan and pump optimization and lighting and melting have the highest total energy saving potential [20].

Lightening is often neglected when considering energy savings, as most times more emphasis is placed on bigger apparatus. Many usage assessments show light is misused and that much energy can be saved by inculcating simple behavioral changes [21]. A number of guidelines can be put in place for the management of energy Changes such as reducing the amount of lighting time, putting off lights when not needed, using only the needed light when required can conserve cost. Old bulbs can be replaced by high efficiency lighting, such as fluorescent lamps [22]. Nevertheless, replacement of light bulbs has to be cautiously carried out as acceptable lighting levels in precise areas of operation have to be satisfied when choosing a replacement. A study was done on Canadian Foundries on the effect of how substituting lighting can result in a non-desirable decrease in brightness, which led to the development of illumination standards for foundries [23]. Effectual use of lightening energy can be enhanced with the various processes;

Incandescent bulbs can be replaced with low wattage bulbs or florescent lamps which demand little energy. Reflectors can be attached to florescent lamps to make the most of the light in appropriate areas by reflecting lights to that area. This reduces the total number of lamps that will be needed, therefore reducing energy consumption. It is imperative to fully identify that when introducing an induction furnace there are certain fundamentals that must be satisfied. With the precise understanding proper choices can be made on the size and shape of charge material, size of furnace and the connection with pouring line and layout of the melting shop. Energy effectiveness in the melting process can be enhanced by warm up of the charge materials, heat recapture systems and operational modifications such as lagging of the furnace [24]. Compressor in foundries are used to compress air used in the mould and core production process. According to the total life sequence cost of a compressed air system, the overhead costs accounts for about 75% while venture and preservation

costs are inconsequential [25]. According to study it is found that many foundries report that compressed air is the next major agent of energy depletion after melting process [24, 25]. Regular maintenance on compressed air leaks all through the plant will surely lead to decrease of extra power losses. Compressed air loss is a major worry in many foundries as it pricier than water, electricity and even steam. Therefore, leaks in this area lead up to major expenses.

The present state in the economy of the world, the trivial and middle scale business plays an essential role. It produces several things which are key to humanity and energy proficiency is far more a key factor for them to cogitate, because they do not constantly have access to stand by generators to provide their power throughout shortages. The foundry industry to a level is part of the trivial and middle scale business, because persons control foundries to manufacture various products to meet client's demands. A huge percentage of the operation expenditures of a foundry is the cost of energy. Therefore, energy management is a vital activity in a manufacturing region as it moderates cost [22, 23]. The mounting need for power has led to a rise in fossil fuels consumption which has brought about an unfavorable impact on nature. In this perspective, effective use of energy and its conservation is of vital significance [20, 21]. There are additional factors which have led to growth in energy consumption, such as: the choice of technology that is engaged is basically reliant on the accessible funding, workshop space and practical skill. This is an enormous difference between the big businesses that have optimum funds to obtain significant technology for effective production. Majority of the little foundries do not have access to significant material and knowledge regarding upgraded procedures of operations in their field. This is perceptible in their methodology and the neglect for well-being of staff. Managerial skills are little in most little foundries. This shows in situations where energy saving procedures are recommended and are ignored due to management seeing it as depletion of finances and not looking outside the original investment to see the cost saving potential of such developments.

Energy depletion in your foundry can be brought down without forfeiting total productivity. This can be accomplished by making adjustments in numerous areas. The use of renewable energy moderates the total amount of fossil fuels that needs to be consumed to produce electricity. Solar panels can be mounted to produce electricity. The management of energy is a primary activity in the manufacturing sector as it decreases operating costs. Appropriate management of energy is vital to addressing the energy saving potential regarding energy usage in a foundry industry. Energy utilization and procedures of conservation is not just measured grounded on equipment accessible, it is also concerned with the technical know-how of the whole operation. It doesn't essentially demand capital investment but an adjustment in company philosophy.

4. Conclusion

Energy consumption is a critical factor in foundries which can affect the overall productivity. It has been proven that the melting process consumes the biggest part of the energy utilized in foundry and this has directed foundries to employ more energy efficient melting technologies. Other factors that lead to high energy consumption in foundries include deficient lagging and depraved preservation culture, poor lightening techniques, inferior administration skills and poor working environment. Therefore, it can be concluded that there is potential for reducing the energy consumption and increasing the productivity.

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