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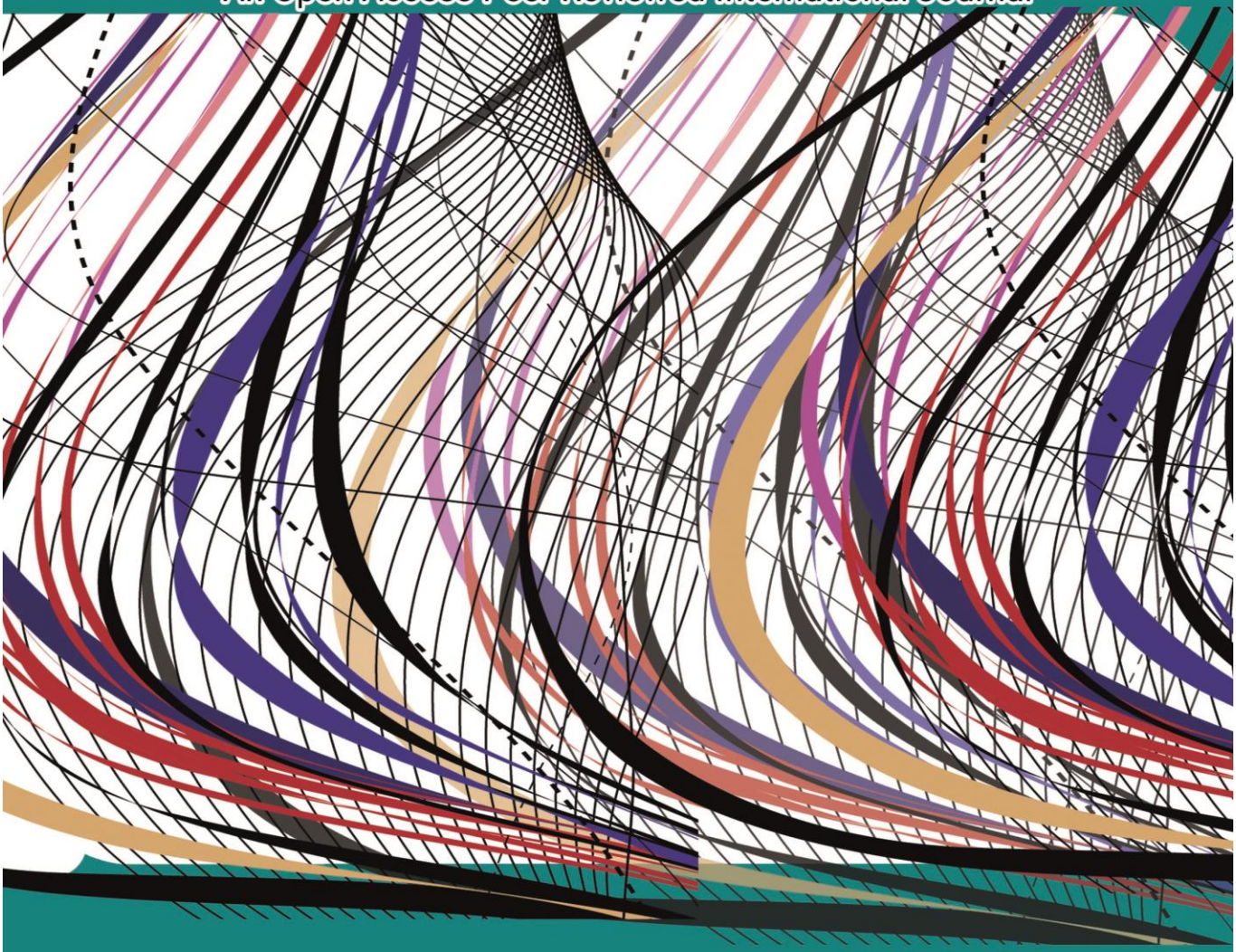

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FOREWORD

I am pleased to put into the hands of readers Volume-5; Issue-5: May, 2019 of **"International Journal of Advanced Engineering, Management and Science (IJAEMS) (ISSN: 2354-1311)" ,** an international journal which publishes peer reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers.

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Dr. Dinh Tran Ngoc Huy
Editor-in-Chief
Date: June, 2019

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Industry 4.0: Technology Mapping and the importance of Cognitive Ergonomics

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***Abstract*–** *The fourth industrial revolution brings a new paradigm, based on advanced manufacturing and industrial internet. So much has been debated about the knowledge and skills of Operator 4.0. However, the cognitive aspects that are intrinsic to this new paradigm are not considered in these analyses. This work aimed to study the Industry 4.0 under a macro, based on information standardization and technology mapping, and a micro vision focused on cognitive ergonomics. Industry 4.0 attributes pointed to an increasing industry complexity during a technological virtualization process, requiring faster and assertive decisions in the face of a wide range of information. It was found that the Operator 4.0 will oversee the solution of increasingly interdisciplinary problems in a digital environment, requiring denser cognitive efforts and more accurate social-emotional skills, such as communication, motivation, autonomy, perseverance, resilience, collaboration and creativity. The case study pointed out as a highlight the Online Predictive Maintenance, which aims to obtain predictability of failure for each component monitored in machines and equipment. The operating routine linked to this new technology confirms how much mental processes will be required in the face of the Industry 4.0 scenario, since a high flow of information was verified, associated with the rapid decision-making in the use of new technologies.*

Keywords*– *Industry 4.0, Technology Mapping, Cognitive Ergonomics.

I. INTRODUCTION

The Internet of Things (IoT), in which people, processes and products are part of the same system, led to the emergence of Industry 4.0, in which, similarly, supply, manufacturing, delivery and customer are connected in real time. The term Industry 4.0 emerged from the report of the Industry-Science Research Alliance group, which was presented to the German Chancellor and launched at the Hannover Messe in 2013. According to the literature, although there are new solutions arising from the fields of IoT and Industry 4.0, a clear definition of the multiple aspects and perspectives from advanced manufacturing and cyber-physical systems is still not observed, especially in the academic scope [1]. Therefore, systematic reviews of the literature, as well as exploratory and descriptive studies, are important tools to provide evidence for the practices decision making in Industry 4.0 and to allow a more in-depth investigation on the subject by the scientific community.

The implantation worldwide trend of Industry 4.0 follows in advanced industrialized countries and is defining a new era of production based on cyber-physical systems, which in turn are the bases for intelligent machines, industry facilities, and storage systems that to be able to exchange information and make decisions independently from controllers [2]. Thus, this "intelligence" is expected to become responsible for revolutionizing industrial production and associated services. In the scope of Industry 4.0, the automation of manufacturing plants occurs based on technologies such as IoT; Big data; Intelligent Robotics; Industrial Automation; Analytics; and others, considering a connection between technologies and between these technologies and data of labor, inputs, energy and production. Thus, conventional computing will have difficulty staggering with the large data flow and with the complexity of the analysis, and it must become cognitive to process, analyze and optimize the information [3].

From of Industry 4.0, due to its unique and innovative characteristics, may require a new type of worker requiring an optimized formation of qualified professionals to work in this type of organization, in order to guarantee the health, safety and satisfaction in the work environment, as recommended by Ergonomics.

In this sense, on the part of Operator 4.0, mental and cognitive requirements will also be much greater, including the mastery and operationalization of the various technologies, as well as analysis of a variety of workflow, process and environment information to boost quality, operations and accelerate decision making in an

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assertive manner. Therefore, the technological process study of Industry 4.0 under the focus of Cognitive Ergonomics, which is a field of Ergonomics specialization, becomes of great value, since challenges will arise from the new intellectual demands linked to intelligent systems.

Lastly, it is noteworthy that there are still few studies in the literature that propose to investigate the Industry 4.0 under a procedural logic; nor is there research that aims to analyze this new concept under the ergonomics approach in its cognitive domain, being something of great value since challenges will arise from the new mental demands linked to intelligent systems. Thus, the present study had as general objective to study the Industry 4.0 under a macro vision, based on the standardization of information, and under a micro vision, based on ergonomics, particularly in the field of cognitive ergonomics.

1.1 Industry 4.0: elements and attributes

In the second half of the 18th century, there was the 1st Industrial Revolution, which mobilized the mechanization of production through the use of water and steam energy, followed by the 2nd Industrial Revolution in the late nineteenth century, in which mass production, with the help of electric power, was the main means of modifying industrial processes. In the middle of the 20th century, the 3rd Industrial Revolution brought the advancement of electronics and manufacturing robotics, and today is already considered the new era of the 21st century, the 4th Industrial Revolution, in which the digital revolution and the use of Information Technology (IT) will further automate manufacturing, moving into the scope of Advanced Manufacturing and Industrial Internet [2].

According to [3], the integration of the Internet of Things (IoT) and Internet Services (IoS) in the manufacturing process initiated the 4th industrial revolution. IoT enables systems and objects, such as sensors, actuators and mobile phones, to interact and cooperate with their neighbors through "smart" components, to achieve common goals. In this sense, IoT can be defined as a network where cyber-physical systems cooperate with each other through exclusives addressing schemes. The Internet Services (IoS), in turn, allows companies to offer their services through the Internet, consisting of individuals, services infrastructure, business models and the services themselves [4].

Inserted in the fourth industrial revolution, the concept of Industry 4.0, created by German researchers, emerges. In October 2012, a working group in Industry 4.0, chaired by Siegfried Dais, vice chairman of the Board of Directors of Robert Bosch Healthcare, and Henning Kagermann, a member of the German Academy of Science and Engineering, presented to the Germany federal government, the concept for the integration of advanced control systems with the internet, allowing the communication between people, products and complex systems [5].

The main approach, present in this new industry concept, is based in to become direct the cooperation and communication between people, machines, equipment, products and logistics systems, using production systems with embedded technology, composed of sensors already integrated to intelligent actuators, also counting on the direct communication with the control of operation, called cyber-physical system [6,3].

In fact, an important component of Industry 4.0 is the merging of physics with the virtual world [3], and this integration is possible through the Cyber-Physical System (CPS). According to [7], CPS refers to the integration of computers and physical systems into a single process, in which they both feedback and interact, playing a key role in Industry 4.0, which depend on cyber-physical connections to play its role. The development of CPS is characterized by three phases: (1) the first generation of CPS included identification technologies such as RFID tags, which allowed unique identification, and storage and analysis should be provided as a centralized service; (2) the second generation of CPS is equipped with sensors and actuators with a limited range of functions; (3) third generation CPS can store and analyze data, being equipped with various sensors and actuators and are compatible with the network [6].

Therefore, industry 4.0 can be understood as an intelligent factory that encompasses automation technology and real-time data exchange, using internet, cloud computing and cyber-physical systems to execute, predict and correct process in the fastest and most efficient way [2]

In order to characterize this emerging industry concept, it is worth reflecting on the key attributes of Industry 4.0. Interoperability is a very important element of this new type of industry, because CPS and humans are linked to IoT and IoS, so standards will be a key success factor for communication between CPS from various manufacturers. Thus, interoperability means that all CPS within the plant are able to communicate with each other over open networks. Virtualization, as another attribute, expresses that the CPS are able to monitor physical processes, so that these sensors and data are linked to virtual plant models and simulation models [8].

Decentralization, on the other hand, starts from the point that the growing demand for individual products makes central processes control increasingly difficult. The incorporated computers allow CPS to make their own decisions, and only in cases of failure will the tasks be

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delegated to a higher level. However, to ensure quality and traceability it is necessary to monitor the entire system at any time.

Real-time capability is also critical for Industry 4.0, because for organizational tasks, the data needs to be collected and analyzed in real-time, in this sense, traceability of the process can be verified, and immediate action taken immediately.

Another attribute, the service orientation, states that CPS and other resources are available through IoS and can be used by other participants, being offered both internally and across company boundaries. Finally, there is the modularity attribute, in which modular systems are able to flexibly adapt to changes and expansions by individual modules. Therefore, modular systems may be suitable in case of seasonal fluctuations or changing in product characteristics. [6, 1, 9, 5]. Table 1 presents the main attributes in summarized form.

Table. 1: Key attributes of Industry 4.0

Attributes	Characteristics
Interoperability	Communication and connectivity of cyber-physical systems, intelligent and human factories.
Virtualization	Virtual copy of Intelligent Factories (data, simulations, models).
Decentralization	Decisions without human intervention.
Real Time Capacity	Data collection, analysis and response in a short time.
Service Orientation	Providing services through Cloud Computing.

Source: adapted from [9].

1.2 Ergonomics and its domain of cognitive specialization

According to the International Ergonomics Association [10], Ergonomics is the scientific discipline that deals with the understanding of the interactions between humans and other elements of a system, and the profession that applies theories, principles, datas and methods to projects, in order to optimize human well-being and overall system performance. The Ergonomics Society (England) defines Ergonomics as the study of the relationship between man and his work, equipment, environment and, particularly, the application of the knowledge of anatomy, physiology and psychology in the solution of the problems that arise from this relationship.

Historically, in 1857, Jastrezebowisky published an article entitled " Ergonomics Essays or Work Science" and the theme was taken up almost a hundred years later, when in 1949 a group of scientists and researchers met in order to formalize the existence of this new field of application interdisciplinary approach to science in 1950, during the second meeting of this group, the neologism "Ergonomics", formed by the Greek terms Ergon (work) and Nomos (rules) was proposed. Thus, in the early 1950s, in England, the Ergonomics Research Society was founded. In 1959, representing a great advance in the area, was founded the International Ergonomics Association - IEA and, in the Brazilian context, in 1983 was created the Brazilian Association of Ergonomics - ABERGO [11].

Ergonomics is a science oriented to a systemic approach and that currently extends to all aspects of human activity and whose objective is to study the factors that can influence the productive system, seeking to reduce its consequences for the worker. The fields of ergonomics specialization are physical ergonomics, organizational ergonomics and cognitive ergonomics [12, 13].

Physical ergonomics seeks to study the relationship between physical aspects and work, encompassing the analysis of human anatomy, anthropometry, physiology, and biomechanics, and others. Under this domain, we can mention some topics of study: posture analysis; lifting of cargo; repetitive movements and job design [12, 13].

In the scope of organizational ergonomics, there is the optimization of socio-technical systems, which involve human beings and management techniques, organizational structures, policies and processes. Topics of study in this domain are the work designs, cooperative work, organizational culture and quality management [12, 13].

Finally, cognitive ergonomics, object of study of the present work under the focus of industry 4.0, studies how human beings interact with several elements of a system, analyzing aspects of mental processes, such as perception, memory, motor response, reasoning, and others. Thus, the mental load of work; decision-making; human-computer interaction and stress are topics of cognitive ergonomics [12, 13]. It is noticed that many of the mentioned items are directly related to the new demands of the Industry 4.0, due to the flow and speed of transmission of the information, need for accelerated decision making, approaches based on intelligent information, causing in the professional high demands of the processes mental, in order to enter the scope of Cognitive Ergonomics study.

II. METHOD

The present work can be considered an exploratory study, integrating bibliographic research and data collection and analysis. Initially, a review of the literature was carried out to identify the guiding principles and concepts of Industry 4.0 in order to be able to develop a technological mapping and analyze the potential implementation challenges. The following academic databases were used: Web of Knowledge, Scopus, SAGE Journals and Scielo; the main fields of research

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encompassed Engineering, Advanced Manufacturing, Industrial Internet, Production Technology, Cyber-Physics, Information Security and Cloud Computing. Criteria for inclusion and exclusion of articles, definition of information to be extracted from articles, analysis, discussion and presentation of results were considered as stages of bibliographic review.

For the development of technological process mapping, a single case study was developed using as a model a multinational company from the interior of the state of São Paulo that offers products and services to the market and automotive assemblers, in the same way for power tools and security solutions, and that already applies the precepts of the Industry 4.0 in its line of production. The case study was chosen in order to allow an in-depth analysis and with varied sources of information of a context, that one wishes to study [14]. The choice of the use of a single case, single case study is appropriate when it is desired to determine if what is proposed on a theory is correct, but there are not many similar situations for other comparatives, or if the information is difficult to [15].

One of the organization's processes was taken as an example for study. Said process is based on the maintenance and monitoring of the indicators of the production line of systems for gasoline engines, in order to cover processes essential to the operation of the line through the integrated systems by the concepts of Industry 4.0.

The analysis from the point of view of cognitive ergonomics was based on the identification of the mental requirements to work in the middle of intelligent systems, understanding the necessary qualifications for Engineer 4.0. In addition, the attributes of Industry 4.0 and its potential relationship with cognitive ergonomics were identified.

III. RESULTS AND DISCUSSION

Using as a study model the gasoline systems plant of the company on which a case study was carried out, it was observed that industry 4.0, in relation to industrial development, covers the four aspects that share what one has today, but with the focus and perspective of the future of manufacturing, as below.

(1) Factory: As one of the main components of Industry 4.0, the future factory will involve a new integration, which not only all manufacturing resources (sensors, actuators, machines, robots, conveyors, etc.) will be connected and will automatically exchange information, but will also be conscious and intelligent enough to predict and maintain the machines, to control the production as well as process and manage the manufacturing system. In addition, many manufacturing processes, such as product design, production planning, production and services, will be modularly simulated, and then, connected, so that, in addition to being decentralized, these processes are controlled independently [16].

(2) Business: Kagermann et al. [17] state that Industry 4.0 implies a complete communication between several companies, factories, suppliers, logistics, resources, customers, etc. Each section optimizes its configuration in real time, depending on the demands and status of the associated sections in the network, which makes maximum profit for all cooperatives with limited sharing capabilities. Thus, the future commercial network is influenced by each cooperating section, which could achieve a status of self-organization and convey the real time responses.

(3) Products: Abramovici [18] presents products that will be integrated with sensors, identifiable components and processors that carry information and knowledge to transmit functionality, guiding customers and transmitting feedback to the manufacturing system, and thus, contributing to development of the entire production chain.

(4) Customers: A new purchase method will be provided to customers, which can change your order and ideas at any time during production, even at the last minute at no cost. On the other hand, the benefit of intelligent products allows the customer not only to know the production information of the product, but also to receive usage information depending on their own behaviors [19]

The Line integration and interoperability are, therefore, only part of the Industry 4.0 system, which must be integrated end-to-end, from the customer to the supplier, to optimize the chain as a whole. The significant improvement of the production and information flow was observed in the implementation of the Industry Systems 4.0 in the company being studied.

To guide the development of the industry 4.0, it was observed, in the present work, the adequacy of the proposal recommended by Lee et al. [7] by means of the 5C architecture (Table 2). This architecture is divided into five levels: connection level; conversion level; cybernetic level; level of cognition; and configuration level.

The connection level focuses on hardware development, which is performed by the sensor network and wireless communication, and the other four levels pay attention to system control and software implementation. At the conversion level, raw data is transformed into useful information using data analysis technologies. The Cyber Level controls the entire network through the CPS. The level of cognition and configuration level involve the

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artificial intelligence in the network, which are considered as future attributes of the fabrication. Manufacturing intelligence is the main target of many researchers interested in Industry 4.0, which is represented by these two levels. Comparing the attributes of these two levels and those of Industry 4.0, the level of cognition is considered as a lower level of Industry 4.0, while the level of configuration tends to reveal higher level characteristics of Industry 4.0 that are considered the industry achievement.

Table. 2: 5C Architecture for Sector 4.0 Implementation

Architecture 5C	Primary attribute	Main registration
Connection Level	Communicable	Hardware Connection
Conversion Level	Informational	Discovery of information
Cybernetic Level	Controllable	Automated System
Level of Cognition	Self-cognition	Predictive Maintenance
Configuration level	Auto-configuration	Intelligent production

Source: adapted from [9].

Therefore, when these various types of ideas (future visions, research examples, and deployment architecture) are merged and summarized under Industry 4.0, several future manufacturing concepts have been abstracted. These concepts are the main design principles of Industry 4.0, which boils down to interoperability and awareness. These two main design principles include many subsets, so that interoperability consists of digitalization, communication, standardization, flexibility, real-time accountability and customization. In turn, predictive maintenance, decision-making, intelligent presentation, self-approval, self-optimization, and self-configuration comprise consciousness.

Analyzing the current manufacturing system and comparing them with Industry 4.0 concepts, it has been found that only manufacturing systems automated recently (automated one station cell, automated assembly system, flexible manufacturing system, computer and reconfigurable manufacturing system) are involved in the scope of the fourth industrial revolution [20]. Each system is detailed below.

In the case study developed, the company under study adopts the manufacturing system with cells single-station automated, automated assembly, adopting the computer control and integration of the manufacturing, necessary for Industry 4.0, and has flexible cells, adapting the demand variations when required.

- **Automated single station cells:** In contrast to the manned cell, the automated cell is fully automated. The machines used are not serviced by any worker for more than one machine cycle. Labor costs declined, and productivity increased in comparison to the manned cell. However, this system also targets batches of constant products. A typical single station automatic cell is composed of one or more automated machines (a set of machines) and an automatic loading and unloading system, such as robots, conveyors, etc. The CNC machine center system is a common example of this system, which can change the tool, position the product and change the axis automatically [21].
- **Automated assembly system:** the production of bigger manufacturing was built into the assembly automation. Compared to the manual assembly system, this system uses a handling system (usually industrial robots) to replace the workers' tasks. A fully automated assembly system is fixed, which is designed to carry out a fixed order of assembly programming on a specific product. This requires the system to be highly stable without changing the design of the product during production, which means that the system components are limited. However, this system commits itself to products of high demand, usually considered in millions. The system components are similar to those of the manual system, but with two important parts that replace the workers: the handling system and the feeding system. In addition, the control includes sequence control, safety monitoring and quality control, which is also automated. One of the most common applications of automated assembly systems is the machining of lamination and sheet manufacture, lamination operations, spot welding, plating operation and others [21].
- **Flexible manufacturing system:** it is a highly automated application of "group technology", in which flexibility is the main feature. However, a flexible manufacturing system is designed for a family of specific parts, which is not completely flexible. In this system, multiple workstations are connected to an automated transport power system controlled by a distributed computer system. Every work piece is identified during the production cycle, which is able to change processing immediately. Therefore, in this system, the machine and the use of materials are increasingly improving with a small number of employees and system space, which also reduces

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inventory requirements. In addition, with the high flexibility, the system can make the rapid responsiveness required for change [21].

- **Computer-integrated manufacturing system**: it was first claimed in 1973 by Joseph Harrington. However, it did not attract the attention of engineers until 1984, when the computer and the automated system began to be developed in the manufacture. The computer integrated into the manufacturing system leads to a fully automated manufacturing, where computers control all functions. In addition, in the simplest system, at least two integrated computers are required to exchange the information. In this system, production can respond quickly with less error. Finally, the most important capacity of this system is cooperative automation [22].

The identification and analysis of the best practices applied by the company under study, regarding the new technologies that are being implemented for Industry 4.0, pointed out as a highlight the Online Predictive Maintenance that aims to obtain predictability of failure for each component monitored in machines and equipments.

Using vibration and temperature sensing for the monitoring of machines and equipments of interest, data is sent in real time through the collection and reading devices of sensors called gateways, to supervisory software and web platforms that are responsible for the consolidation and display of the datas in order to facilitate reading and interpretation through charts and reports.

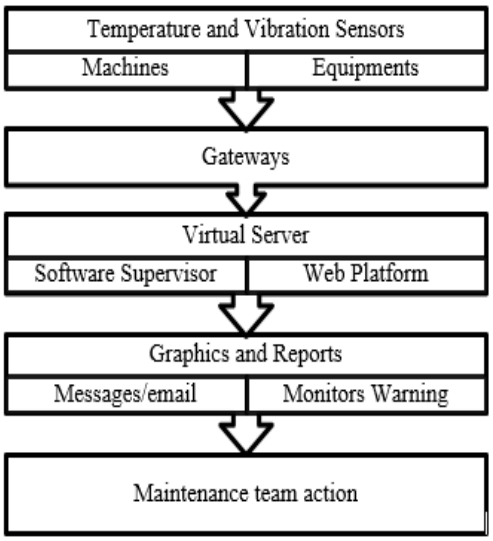

Fig. 1: Flow chart corresponding to the Online Predictive Maintenance process

Souce: Own elaboration (2018).

In order to monitor the faults, critical warnings are sent by email, messages to mobile devices, and through the graphics displayed on the monitors as well, increasing the efficiency of predictive maintenance and reducing corrective maintenance activities, as noted in the flowchart below. Figure 1 shows the flowchart corresponding to the Online Predictive Maintenance process.

With the specific monitoring of the machines and equipment in the company under study, it is possible to observe standards in its operation and through the connection with CPS, the immediate analysis of data allows the identification of possible future failures through small changes in its graphs of operation. In this way, operators and maintenance managers are able to visualize, by their devices and by means of the notices issued, the necessary information of the reports. At the same time, the system shows the defective part and fire the maintenance team, which at the next production stop moves with the component to be replaced at hand and performs the necessary operation, thus optimizing maintenance without stopping production unexpectedly because of a piece breaking.

This operating routine confirms how much mental processes will be required in the context of the Industry 4.0 scenario, since it was verified a high flow of information associated with rapid decision-making in the use of the new technologies was so that a growing industrial complexity in to a process of technological virtualization will require new skills of this professional.

This operating routine confirms how much mental processes will be required in the context of the Industry 4.0 scenario, since it was verified a high flow of information associated with rapid decision-making in the use of the new technologies, so that it will require new skills of the professionals.

The correct application of engineering knowledge's leads to the critical analysis of the required employee's qualifications inserted in the context of advanced manufacturing and industrial internet, specifically the so-called Engineer 4.0, allowing listing four essential requirements: (1) interdisciplinary training; (2) adaptability; (3) sense of urgency; and (4) good interpersonal relationships. In fact, the engineer will have to break and surpass the search only for technical solutions to a problem, necessitating the interaction with professionals of diverse areas, of creativity and of the adaptive capacity [9, 1].

In front of the case study, it was also observed the operator's difficulty to assimilate the new applied technologies, since previously it was used printed worksheets and general reports, so that, they did not deal with the volume of data now administered, raising the cognitive requirement of them, generating discomfort for the unknown and fear of possible layoffs for performance. For the improvement of cognitive ergonomics, we suggest

https://dx.doi.org/10.22161/ijaems.5.5.1 *ISSN: 2454-1311*

the matrix training by area, divided in 4 steps, from A to D, in which the scope is adapted by operation, teaching them the operation of the general monitoring system until the operation that must be performed.

It was observed a significant improvement in operation and productivity after the completion of training. The load of cognitive requirements was maintained, but with the assimilation of the new technologies and the correct learning of the operation of them, it helped the operators in the execution of their activities.

IV. CONCLUSION

The fourth industrial revolution brings with it a new paradigm, based on advanced manufacturing and industrial internet. Thus, it has been found that the requirement for mental and cognitive processes within the scope of industry 4.0 will certainly be distinct from that required in traditional industry due to the flow and speed of information transmission, the needing for accelerated decision-making and approaches based on intelligent systems, demanding from the professional many intellectual activities, so that enter the cognitive ergonomics study area. In addition, it is a consensus that there is no standardization of information on the subject matter, especially in the academic field, difficulty more in-depth investigations by scientific community.

The case study developed highlighted the Online Predictive Maintenance, which aims to obtain predictability of failure for each component monitored in machines and equipment. The operating routine linked to this new technology confirms how much the mental processes will be required in the scenario of Industry 4.0, since a high flow of information was verified, associated to the rapid decision making in the use of the new technologies.

In fact, specifically in the field of Engineering, much has been debated about the Engineer 4.0 formation, and in this study, it was found that the engineer will be connected to the solution of increasingly complex problems in a digital environment, requiring denser cognitive efforts and skills socio-emotional, such as communication, motivation, autonomy, perseverance, self-control, resilience, collaboration and creativity.

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Development of Computer Models for Simulating the Optimum Design Parameters of a Passive Solar Heating Chicken Brooder System

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***Abstract*— *Brooding refers to early periods of growth when chicks require supplementary heat to maintain their normal body temperature. Generally, chicks kept in environmental temperatures outside their comfort zone suffer low growth and high mortality rates. Solar energy has a regular daily and annual cycle, and is unavailable during periods of bad weather. Hence requires special storage and distribution of the energy different from the utilization of conventional energy sources. In this study computer models were developed for simulating internal brooder envelope brooding Temperatures and ammonia gas concentration in ppm. Further, analysis was carried out to determine the influence of trombe wall thickness on the variation of hourly internal brooder temperatures for various months of the year. The trombe wall thickness were set at 100,150, 200, 250 and 300mm and hourly temperatures simulated using Matlab computer program. The wall thickness of 100mm and 150 mm yielded maximum brooding space temperature of 36.5^0C and 35.3^0C respectively. The resultant brooder temperatures were above the optimal brooding temperature range of 34^0C for day one and 21 to 24^0C for the 28^{th} day of brooding. However, the lowest brooder temperatures attained for 100mm and 150mm wall thickness were 29.5^0C and 30.8^0C respectively. The wall thickness of 300mm yielded temperature range of 25.7^0C to 28^0C.From this study it is deduced that the wall thickness of 100 and 150mm are suitable for development of a chicks' brooder. Though, supplementary source of heat will be required to keep the birds comfortable for the first one week of brooding period. The brooder pH was set at 10 and the ammonia concentration simulated for 28 days at brooding floor temperatures of 14.8^0C, 18.7^0C, 22.6^0C and 27.4^0C.The results were that the ammonia concentration increased exponentially from day one to the 28^{th} day of brooding for all the floor temperatures. The highest emission of ammonia was recorded at the temperature of 14.8^0C for the first fifteen days; but after the 15^{th} day the temperature of 18.7^0C recorded the highest emission of ammonia. Conversely, the temperature of 27.4^0C yielded the lowest ammonia emission. Therefore, it is essential in the design of brooders to have provision for facilitating removal of birds' droppings to minimize emission of the ammonia gas from the floor of the brooder.*

Keywords*— *Ammonia concentration, Brooder, modeling, optimal brooding temperature, pH and simulation.

I. INTRODUCTION

Chick brooding refers to the period from day old, when chicks are hatched to age of about 28 days when the young birds are unable to maintain their normal body temperature without the aid of supplementary heat. Chicks exposed to temperatures below 34^0C on the first day and below $21\ ^0C$ by day 28 of life makes the young birds uncomfortable, hence feed and water intake required for good start are lowered. The consequences being poor feed conversion, high disease incidences, reduced growth rate and in extreme cases high mortality rate. According to [1], 75% of poultry population in Kenya consists of indigenous chicken kept under a free range system in small flocks of less than 30 birds by over 90% of the rural households. Despite their numbers, indigenous chicken have low productivity and only contribute 60% and 50% of the chicken meat and eggs respectively, consumed in the country.

The majority of smallholder farmers with flock size averaging 10 to 50 chickens hardly realize improved productivity, which could be explained by the manner in which they adopt disseminated management intervention package. The management intervention package designed to improve productivity of indigenous chickens include housing, feed supplementation, vaccination, brooding, and chick rearing [2]. Indigenous chickens are of great importance to smallholder farmers. However, farmers face the challenge of improving productivity of their flock that could benefit them to increase financial and food security [3]. Feed conversion is more efficient at optimum temperatures than at temperatures that are colder or warmer

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than the optimum [4], [5].Temperature on the floor, at the edge of the heat source, should be 32 to 35°C for the first week. As long as the temperature at the edge of the heat lamp or brooder stove is this warm, the air temperature 2m away from the heat source can be as low as 28°C. If you cannot maintain a hot point next to the heat lamp, an average air temperature of 30 to 31°C is suggested. The temperature should be reduced by 3°C (5°F) per week, until the room temperature of 20ºC is reached [6].

Artificial chick brooders exist of every conceivable type and size, heated by oil, coal, wood, water, gas and electricity. With the exception of the electric brooders, all other methods are difficult to operate with local skills in rural areas. They do not maintain constant brooding temperature, require foreign currency for importation and are expensive for flock size of less than 1000 chicks. On the contrary electric brooders are economically feasible, could safely and easily be constructed and maintain the desired constant brooding temperature. However, it is difficult to adopt electric brooders by the African rural household poultry producers owing to the unavailability of electric power, numbers of chicks to be raised and remote locations of the farm sites [7].

As chicks grow and mature, the need for supplemental heat is less important whereas, the need for adequate space becomes critical. The initial brooding temperature below the hover should be 35°C at 5 cm from the floor and this initial brooding temperature should be reduced by approximately 3°C per week until 21°C is reached [8]. According to [9], thriving of poultry production in developing countries where electricity supply has remained inadequate and unreliable, therefore, alternative methods of meeting the energy needs in agriculture and in the poultry industry specifically have to be evolved.

Large-scale utilization of solar energy is fraught with problems due to the low flux density of solar radiation and intermittency. This necessitates the use of large surfaces to collect solar energy. Solar energy has a regular daily and regular annual cycle, and is unavailable during periods of bad weather. These daily and seasonal variations in irradiance, exacerbated by variations due to weather, introduce special problems in storage and distribution of this energy which are entirely different from problems involved in the utilization of conventional energy sources as declared by [10] and [11].

The objectives of this study were to develop computer models for simulating the solar energy harnessedby trombe wall for brooding chicks and the performance of the brooding system. Secondly, optimization of the design parameters and evaluation of the performance of the solar heating passive brooder system.

The brooding environment conditions can be predicted by conducting experiments or by using simulation models. Simulation methods provide a quick, less expensive, more flexible and repeatable way compared with the experimental predictions [12].Further, simulation and modeling method is a safe way of conducting studies on animals like chicks to minimize the danger of exposing the young birds to adverse conditions which could lead to high mortalityrates. The results of this study will be used to design and construct solar energy powered brooding systems for further research on use of solar energy for brooding while minimizing the number of trials.

II. METHODOLOGY

This study was carried by modeling and simulation. The brooding space was powered by solar energy collected by the trombe wall and rock storage. The air and heat flow to the brooding room influences the relative humidity, temperature and air quality of the brooding envelope.

2.1 Sources of heat energy to the brooder

The simulations were accomplished using Matlab software with modeling equations and design parameters.Hence the dynamic brooding room temperature (T_{br}) is expressed as shown in equation 2.1.Since the ambient temperature varies according to the time of the day, the internal temperature of the brooder will also vary with the time of the day. Therefore, the energy balance equation of the brooder can be expressed:

$$\rho_a V_{br} C_{sh} \frac{dT_{br}}{dt} = Q_{tw} + Q_{rs} + Q_{bs} + Q_{bl} - Q_{vl} - Q_{fl} - Q_{cl} \quad \ldots\ldots\ldots\ldots 2.1$$

The following were sources of heat gain to the chicks brooding room: Heat gain from the trombe wall (Q_{tw}), heat gain from the rock storage (Q_{rs}), Sensible heat generated by the chicks (Q_{bs}), latent heat generated by the chicks (Q_{bl}). While the heat losses were: Heat loss due to ventilation (Q_{vl}), heat loss through the floor (Q_{fl}), heat loss through ceiling (Q_{cl}).The energy gain or loss of the brooding room is influenced by the internal volume (V_{br}) of the brooder, specific heat capacity (C_{sh}) and the density (ρ_a) of the air enclosed in the room.

The energy from the trombe wall is given by:

$$Q_{tw}=h_{cr}A_{tw}(T_{bs}-T_{rm}) \quad \ldots\ldots\ldots\ldots 2.2$$

The heat gain from the trombe wall is influenced by surface area of trombe wall surface(A_{tw}), heat capacity of the wall material, the back wall surface temperature(T_{bs})and the brooding room temperature (T_{rm}).

The energy from the rock storage is given by:

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$Q_{rs} = h_c A(T_{ds} - T_{rm})$……2.3

Where is (h_c) is duct material specific heat capacity,$(T_{ds})$is the conduct surface temperature, (A) surface area of the duct from the rock storage, and (T_{rm})brooding room temperature.

The sensible heat generated by the birds due to respiration is given by:

$Q_{bs} = 7.97LW^{0.75} - 5.87T_1 + 2.3RH$…….. (2.4)

Where(Q_{bs})sensible heat generated by the birds, (LW)live weight of the birds (T_1)body temperature (RH) brooding room relative humidity

While latent heat produced by the chicks is;

$Q_{bl} = 430LW^{0.75} + 11.3T_1 + 4.45RH$…….. (2.5)

(Q_{bl}) is the latent heat released to brooding room as the birds cool their bodies.

The heat losses include the following:

Ventilation losses through the openings between the brooder and the outside environment are given by:

$Q_{vl} = mc_p (T_{rm} - T_o)$……2.6

(Q_{vl}) heat energy lost due to ventilation.(m) Mass of air leaving the brooding room, brooding (T_{rm}) room temperature, (T_o) the ambient temperature, (c_p) specific heat capacity of the air

Heat losses through the flour;

$Q_{fl} = A_{fl}U_{fl}(T_{rm}-T_{fl})$……..2.7

(Q_{fl})Heat energy lost through the flour of the brooder, (A_{fl})surface area of the brooder floor,$(T_{fl})$the floor temperature and(T_{rm}) the brooding space temperature

Heat loss through the ceiling;

$Q_{cl} = A_{fc}U_{fc}(T_{rm}- T_{fc})$……..2.8

(Q_{cl}) heat energy lost through the ceiling(A_{fc})surface area of the ceiling, (T_{fc})Temperature on the surface of the ceiling

Studies by [13] show that, the overall ventilation heat exchange of a building is the total of the air flows at all the outlets or inlets. The overall ventilation heat exchange is given by $Q_{vl} = mc_p(T_{rm} - T_o)$

2.2 Brooding Envelope Air Quality

This study confined the quality of brooding room air on the amount of ammonia gas emitted in the brooding envelope. The ammonia gas emitted was predicted by;

$E = e^{(-6.5 + 0.12(T) + 0.6Ph + 0.003(day) - 0.0043(day)^2)}$….. 2.9

2.3 Determination of wall thickness that stores adequate energy for optimum brooder temperatures

The wall thickness wereset at four levels, thus, 100mm, 150mm, 225mm and 300mm. These are the sizes of bricks commonly used for construction in Kenya, Secondly,the energy required to create indoor comfort is directly affected by a building's microclimate [13],[14].Further, [15] asserts that, to minimize the utilization of energy systems inside a building to obtain climate comfort which is affected by exterior factors, it is essential tomake sure that the design parameters, which are within the designers control, are selected with suitable values.

The experiments were run using the equations 2.1 to 2.9. The inputs being, mean hourly ambient temperatures per month for whole year, wall thickness of 100mm, 150mm, 225mm and 300mm. While the outputs were; hourly internal brooder temperatures.

The brooder pH was set at 10 and the ammonia concentration simulated for 28 days at brooding floor temperatures of 14.8^0C, 18.7^0C, 22.6^0C and 27.4^0C.Fig. 2.1 is the flow diagram for running the study.

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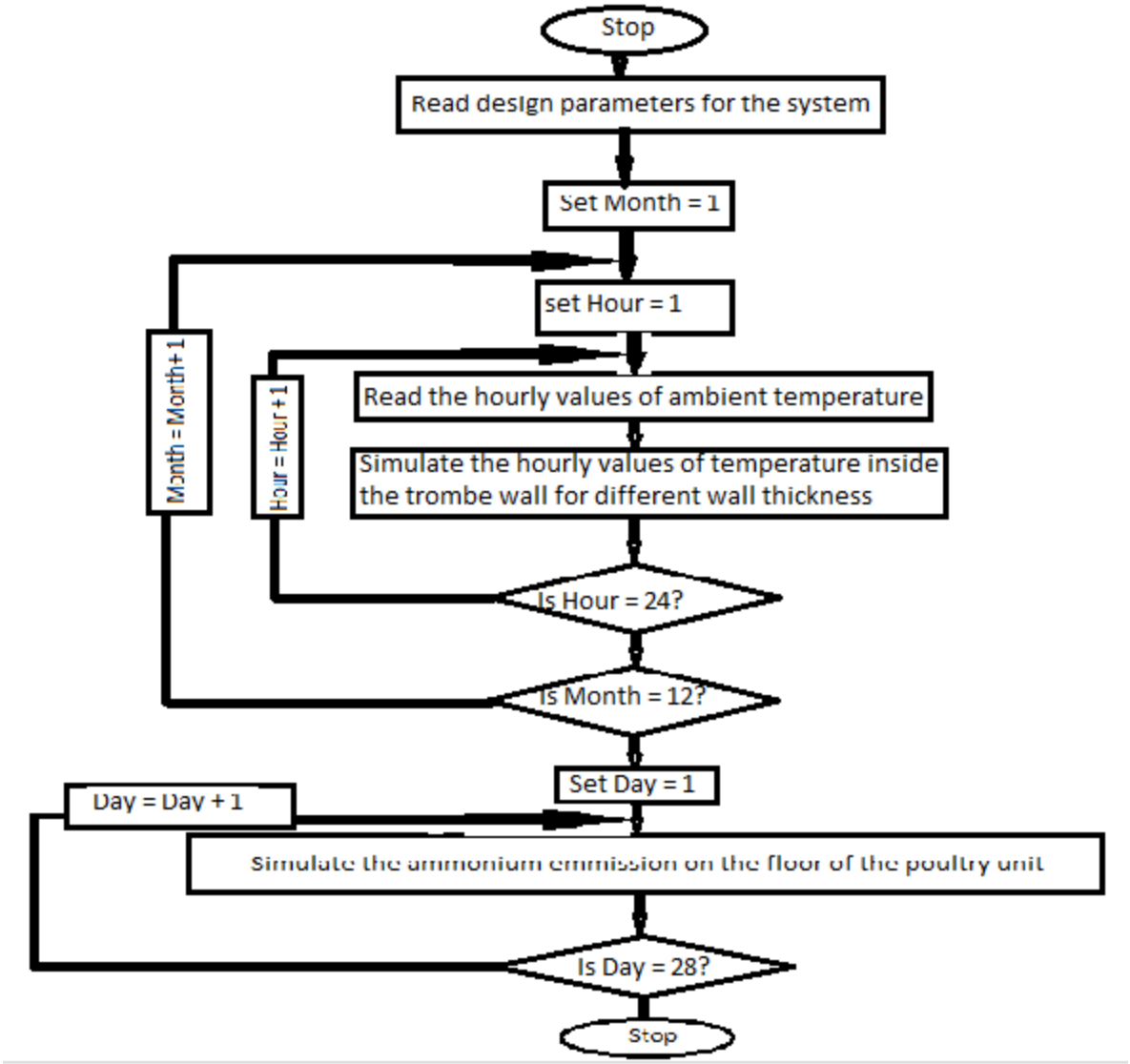

Fig.2.1: Simulating brooder temperatures and ammonia concentration (source: Authors, 2019)

The results of the experiment were correlated to the optimal brooding temperatures and optimum wall thickness established.

III. RESULTS AND DISCUSSION

Plots of brooding room hourly temperatures and ammonia concentrations against 24 hours of the day for the whole year were generated. The results of the simulations to determine the influence of trombe wall thickness on the variation of hourly internal brooder temperatures for trombe wall thickness of 100,150, 200, 250 and 300mm and hourly temperatures; the wall thickness of 100mm and 150 mm yielded maximum brooding space temperature of 36.5^0C and 35.3^0C respectively. The resultant brooder temperatures were above the optimal brooding temperature range of 34^0C for day one and 21 to 24^0C for the 28^{th} day of brooding. However, the lowest brooder temperatures attained for 100mm and 150mm wall thickness were 29.5^0C and 30.8^0C respectively. The wall thickness of 300mm yielded temperature range of 25.7^0C to 28^0C. Fig. 3.1 and Fig. 3.2 show the simulated brooder temperatures for the months of February and May respectively.

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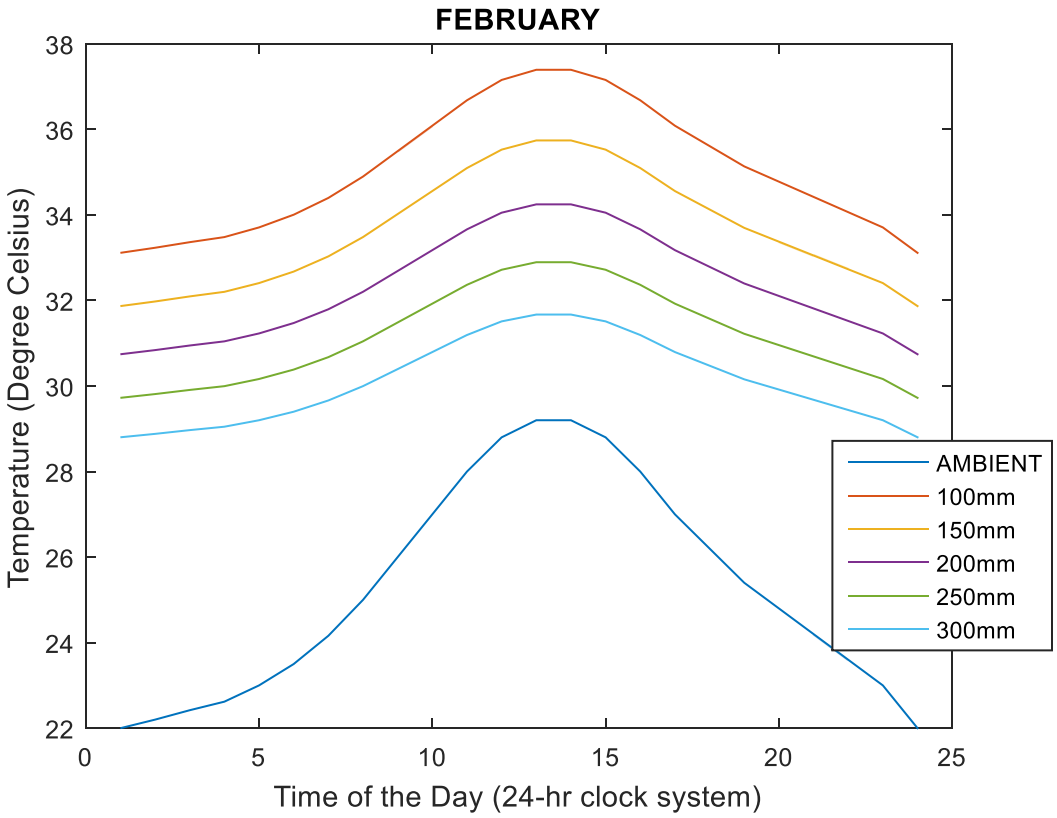

Fig.3.1: Generated internal brooder for various wall thickness. (Source: Authors, 2019)

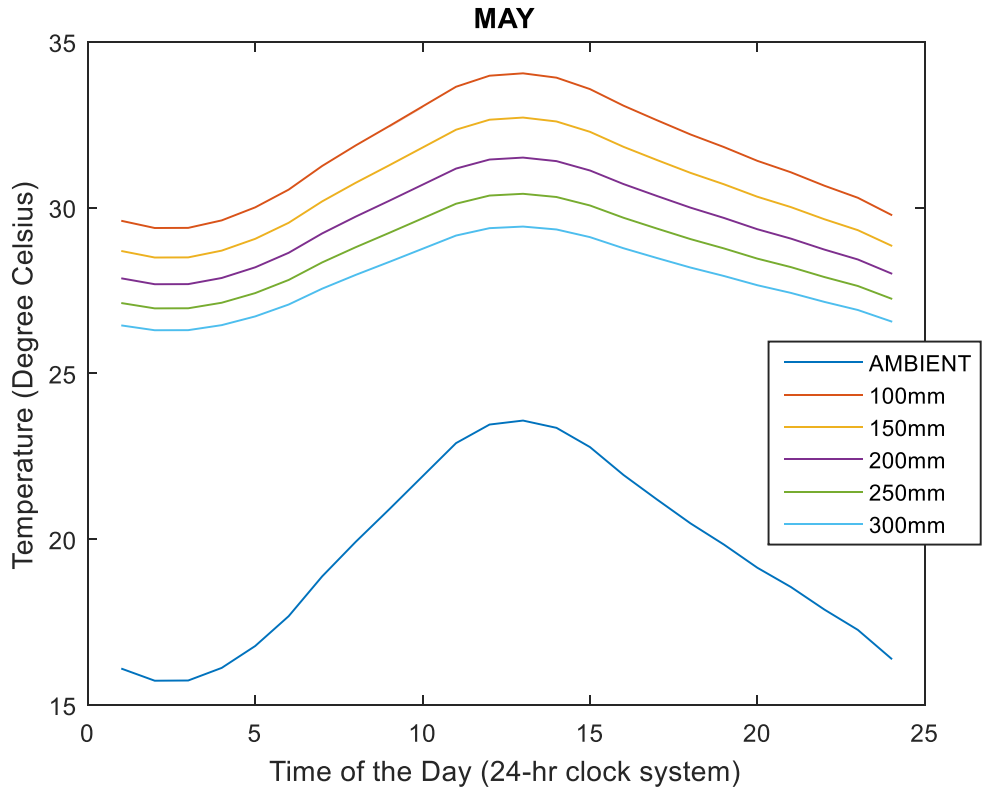

Fig.3.2: Generated internal brooder for various wall thickness. (Source: Authors, 2019)

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From this study it is deduced that the wall thickness of 100 and 150mm are suitable for development of a chicks' brooder. Though, supplementary source of heat will be required to keep the birds comfortable for the first one week of brooding period. Since the temperatures attained in the brooder are slightly below optimal brooding temperatures for the first seven days of brooding. According to [15]the microclimate conditions surrounding a building have a direct impact on the energy consumption necessary to provide indoor comfort. Therefore, type of walling material will influence amount of heat energy required to keep the brooding room temperature within the required limits.

Simulations for ammonia concentration showed that concentration of the emitted gas increased exponentially from day one to the 28th day for brooding floor temperatures of 14.8^{0}C, 18.7^{0}C, 22.6^{0}C and 27.4^{0}C. The highest emission of ammonia was recorded at the temperature of 14.8^{0}C for the first fifteen days; but after the 15th day the temperature of 18.7^{0}C recorded the highest emission of ammonia. Conversely, the temperature of 27.4^{0}C yielded the lowest ammonia emission. Emission of ammonia gas is likely to be caused by birds' droppings, the dampness on the floor and microbial activities on the floor of the brooder. This results show that at high temperatures the amount of heat energy in the brooding room is high, hence the room is likely to be drier consequently less microbial activities on the brooding floor leading to less ammonia generation. Fig. 3.3 shows the ammonia gas emission for the 28 days brooding period.

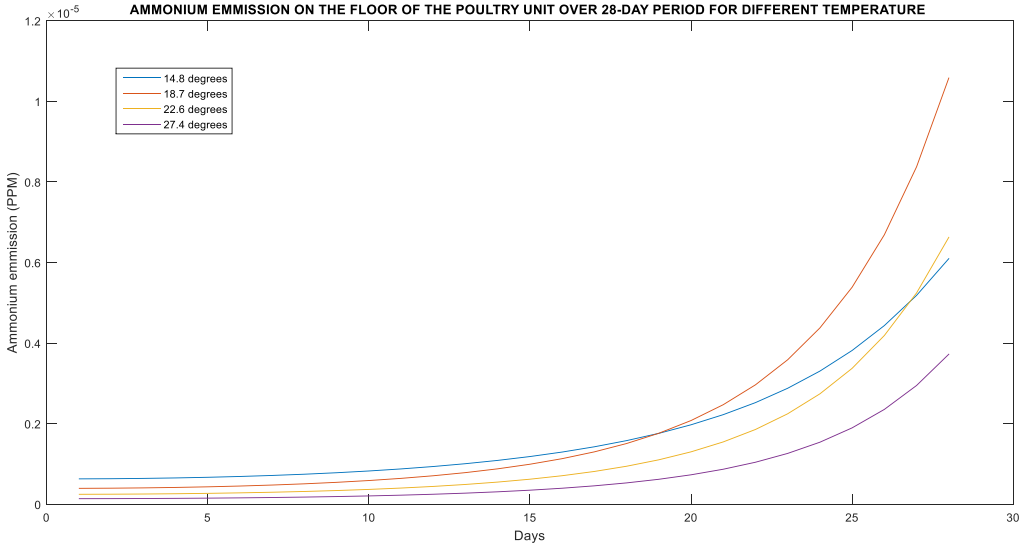

Fig. 3.3: Ammonia gas concentration for 28 days brooding period. (Source: Authors, 2019).

IV. CONCLUSION

This study showed that the wall thickness of 100 and 150mm are suitable for development of a chicks' brooder. Though, supplementary source of heat will be required to keep the birds comfortable for the first one week of brooding period. The exponential increase of the emitted ammonia gas from day one to the 28th day of brooding shows the significance of designing brooders to have provision for facilitating removal of birds' droppings in order to minimize emission of the ammonia gas from the floor of the brooder.

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Modeling the Relationships between the Solar Energy, Trombe Wall Brooder System Parameters and the Brooding Characteristics of Indigenous Chicken

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Abstract— A brooder is a structure where chicken are kept for stimulating optimal growth. Smallholder poultry production in Kenya faces the challenge of appropriate energy source for brooding. The study evaluatedby simulation and modellingthe performance of a trombe wall in a small-scale brooder. The brooder system under study consist of brick walls and wooden slated floor. The internal dimensions of the brooder being 2.5 x1.2 x 1.5 m.A dynamic model was used for predicting the brooding conditions based on; ambient temperatures, total solar radiation, ventilation size, thickness and colour of the heat absorption wall. The absorption coefficient for glazed brick is 0.35, absorption factor of black colour is 0.9, and thefraction of incident radiation absorbed is 0.89. Considering a wall thickness of 0.15m, thermal conductivity of 0.8 W/m K, density of bricks -1760 kg/m^3, surface thermal resistance of the wall - 0.188 m^2K, thermal wall surface area of 3.75 m^2 and the pen capacity at 30 chicks per square metre. The experimental model of the brooder was solved using a Maltilabcomputer program with appropriate model equations. A case study of Eldoret town was used, where mean monthly solar radiation is 540Wh/m^2/dayto 640Wh/m^2/day and daily ambient temperature of 14.2^{0}C to 28^{0}C.The resultant glazed brooder surface temperatures were 77^{0}C to 85^{0}C. In view of the appropriate brooding temperatures for day old chicks being 34^{0}C while at 28 days of age required temperature range is 21-24^{0}C.Consequently, the trombe wall can be used to optimally regulate brooder temperatures. Further, the design expert software was used to establish relationship within solar radiation, trombe wall surface temperatures and the optimal brooder envelope temperatures. The analyses showed a linear relationship amongst solar radiation, trombe wall surface temperatures and the optimal brooding temperatures. The results are appropriate data for designing a brooder for physical and physiological studies of chicks.

Keywords— Brooder,chicks, design parameters, indigenous chicken, modeling, solar energy and temperatures.

I. INTRODUCTION

Brooding refers to early periods of growth when young chicks are unable to maintain their normal body temperature without the aid of artificial supplementary heat (Demeke, 2007). Low temperature results to high mortality rate due to salmonella infection, bunching and crowding with the accompanying evil of smothered chicks. Chicks that become overheated will experience problems like pasting, heat stress, dehydration and eventual death (Okonkwo, 1998). When birds are kept in environmental temperatures above or below their comfort zone, more energy must be expended to maintain body temperature. This extra energy will ultimately be supplied by the feed consumed. Therefore, the energy from the feed will be used to maintain body temperature instead of growth and development resulting in poorer feed conversion (Fairchild, 2012).

According to Kugonza, *et al.*, (2008) indigenous chickens have multipurpose functions in the village economy and the traditional capital system. However, one of the challenges to development of indigenous chicken is housing. Improved management (e.g., housing and breeding) will result in larger indigenous chicken flock sizes, since mortality due to diseases will be reduced (Wachira, *et al.*, 2009). The chick can be easily stressed if its body temperature decreases or increases by as much as one degree. The chick develops the ability to regulate its body temperature around 12 to 14 days of age (Fairchild, 2012). Therefore, it is important to regulate temperatures in the brooder to stimulate optimum growth and minimize mortality of the chicks.

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Most of the current research on poultry has been done on disease prevention and control, nutrition and breeding; but limited studies have been done on housing and brooding systems of indigenous chicken. Further, the research on brooding of chicks has to a great extent been carried out using Broiler chicken. The growth rate and feed intake by broiler chicken are quite different from the indigenous chicken and layers. The smallholder chicken rearing is characterized by natural incubation of eggs leading to hatching of chicks in small batches of less than 15 chicks that rarely fit in conventional chick rearing systems. Synchronizing of incubation is an innovation recommended by livestock breeders; the practice is that ;chicks from two to four hens are given to one foster hen..

According to Ahiaba, *et al*, (2015), thriving of poultry production in developing countries where electricity supply has remained inadequate and unreliable, alternative methods of meeting the energy needs in agriculture and in the poultry industry specifically have to be evolved. These alternative energy needs cannot be over-emphasized, for energy is required at various stages of poultry production. Using biomass energy has the challenge of environmental degradation.

Large-scale utilization of solar energy is fraught with problems due to the low flux density of solar radiation and intermittency. This necessitates the use of large surfaces to collect solar energy. Solar energy has a regular daily and regular annual cycle, and is unavailable during periods of bad weather. These daily and seasonal variations in irradiance, exacerbated by variations due to weather introduce special problems in storage and distribution of this energy which are entirely different from problems involved in the utilization of conventional energy sources as declared by Berg (1976) and Iqball (1983).However, Nwanya and Ike (2012) assert that maintenance of proper brooding temperature is critical to the success of the brooding operation because it impacts on body weight gain.

The objective of this study was to develop the relationships between the incident solar energy, composite solar heating passive brooder system design parameters, and the brooding characteristics of indigenous chicken.

The brooding environmentconditions can be predicted by conducting experiments or by using simulation models. Simulation methods provide a quick, less expensive and more flexible and repeatable way compared with the experimental predictions (Ahmed and Kozai, 2005).

Further, simulation and modeling method is a safe way of conducting studies on animals like chicks to minimize the danger of exposing the chicks to adverse sconditions which could lead to high mortality.

II. METHODOLOGY

2.1 Study location

The simulation and modeling was conducted based on the climatic conditions of University of Eldoret (0.5207^0N and 35.2763 ^{0}E) within Eldoret Town–UasinuGishu county in Kenya.

2.2 Study procedure

This study evaluates by simulation and modelling the performance of a trombe wall in a small-scale brooder. The brooder system under study consist of brick walls and wooden slated floor. The internal dimensions of the brooder being 2.5 x1.2 x 1.5 m.Thermal wall surface area of 3.75 m^2 and the pen capacity of 30 chicks per square metre.

A dynamic model was used for predicting the brooding conditions based on; ambient temperatures, total solar radiation, ventilation size, thickness and colour of the heat absorption wall. The temperature increase of outside surfaces due to the proportion of the absorbed solar radiation was computed using the equation below (Szokolay, 2004).

$T_s = T_o + G^* \rho * R_{so}$ .....(1)

Where T_s (^{0}C) surface temperature,T_o (^{0}C) is the ambient temperature, G (W/m^2) is the global irradiance, ρ absorption coefficient which depends on materials and colour, R_{so} (m^2k/W)threshold level for surface thermal resistance. The absorption coefficient for glazed brick is 0.35, absorption factor of black colour is 0.9and the fraction of incident radiation absorbed is 0.89. Considering a wall thickness of 0.15m, thermal conductivity of 0.8 W/m K, density of bricks -1760 kg/m^3, surface thermal resistance of the wall - 0.188 m^2K, wall surface area of 3.75 m^2 and the pen capacity at 30 chicks per square metre. The experimental model of the brooder surface temperature was solved using a Matlab computer program with model equation (1). A case study of Eldoret town was used, where mean monthly solar radiation is as shown in Table (1). Global radiation G = 1353 W/m^2

Table 1: Mean monthly solar ($kWh/m^2/day$) for Eldoret town.

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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
0.62	0.64	0.62	0.58	0.58	0.56	0.53	0.53	0.60	0.57	0.55	0.61

The mean daily ambient temperature range is 14.2^0C to 28^0C.

The ventilation and air exchange rate are as given by equation (2) and three respectively;

$$\frac{1}{A_i^2}+\frac{1}{A_0^2}=\frac{(2C^2\,GH(T_0-T_i)}{T_iV^2}\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

$$Nq=\rho C_pV(T_0-T_i)+(T_0-T_i)_{\epsilon}A_sU_s\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$$N_q=\rho C_pV\Delta T+\Delta T\sum_{s=1}^{n}A_sU_s\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

$$N_q-\Delta T\sum_{s=1}^{n}A_sU_s=\rho C_pV\Delta T\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

$$V=\frac{N_q-\Delta T\sum_{s=1}^{n}A_sU_s}{\rho\,C_p\Delta T}\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

A_i-Inlet area of vents (m^2),A_0-Outlet area of vents (m^2),C -discharge coefficient of vents (normally 0.6-0.65),g -acceleration due to gravity,H –differencebetween inlet and outlet m, T_1- Inlet air temperature k, T_0 -Outlet air temperature k,$\Delta T= T_0 - T_1$,V- air exchange rate $m^3\ s^{-1}$,N - Number of animals,n- Number ofbuilding surfaces, q -Heat output per animal,ρ - Density of air 1.2 kg m^3,$C_p$specific heat capacity of air, 1010 $jkg^{-1}K^{-1}$,A_s - Surface area of a particular room surface (floor, roof) m^2,U_s -Thermal transmittance of particular building surface (floor,roof).

2.3 Set up for relation relationship within solar radiation, trombe wall surface temperatures and thebrooder temperatures.

The design expert software was used to establish relationship within solar radiation, trombe wall surface temperatures and the optimal brooder envelope temperatures.The appropriate brooding temperatures for day old chicks is 34^0C while at 28 days of age required temperature range is $21\text{-}24^0$C.The parameters considered for the computation of the relationship were; SolarRadiation, brooder temperatures and inlet temperature (ambient temperatures) while the output was Trombe wall surface temperature.The Box-Behnken design led to 3 levels with 5 centre points as shown in table 2 below.

Table 2: Box-Behnken design for solar radiation, brooder temperature and brooder inlet temperature as factors and Trombe wall surface temperature as response.

		Factor 1	Factor 2	Factor 3	Response
Std	Run	A:Solar Radiation	B:Brooder Room Temp	C:Brooder Inlet Temp	Trombe wall o/s Temp
		$Wh/m^2/day$	^{0}C	^{0}C	^{0}C
11	1	590	24	26	
4	2	640	34	21	
3	3	540	34	21	
9	4	590	24	16	
17	5	590	29	21	
14	6	590	29	21	
1	7	540	24	21	
13	8	590	29	21	
10	9	590	34	16	
12	10	590	34	26	
15	11	590	29	21	
2	12	640	24	21	
5	13	540	29	16	
16	14	590	29	21	
7	15	540	29	26	

https://dx.doi.org/10.22161/ijaems.5.5.3 *ISSN: 2454-1311*

8	16	640	29	26	
6	17	640	29	16	

III. RESULTS AND DISCUSSION

3.1 Wall surface temperatures for various time of the day

The glazed brooder surface temperature for all the months of the year for wall thickness of 100,150,225 and 300mm were generated. However, for this study a wall thickness of 150 mm was considered because this is the commonly moulded brick size and used for construction of farm structures in the locality, secondly the resultant surface temperatures throughout the year were above the regular brooding temperatures. Hence regulation of the brooder surface temperatures can be done to achieve the appropriate brooder envelope temperatures when the 150 mm trombe wall is used for brooding.

The resultant glazed brooder surface temperatures for the 150 mm brick wall were 77^0C to 85^0C. In view of the appropriate brooding temperatures for day old chicks being 34^0C while at 28 days of age required temperature range is 21-24^0C. Consequently, the trombe wall can be used to optimally regulate brooder temperatures. Figure 1 shows the brooder surface temperatures for the month of March for various wall thickness with variation in ambient temperatures.

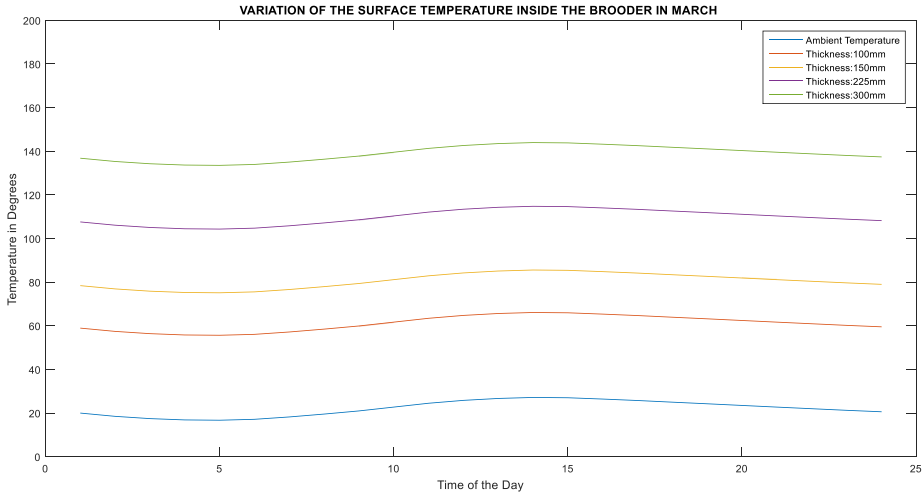

Fig. 1. Surface for various wall thickness for different time of the day

3.2 Relationship within solar radiation, the optimal brooder envelope temperatures and inlet brooder temperature.

The solar radiation,theoptimal brooder envelope temperatures and inlet brooder temperatures sampled for study were; Solar radiation 640, 590, and 540Wh/m^2/day, brooder envelope temperature 24,29 and 34 ^{0}C, brooder inlet temperature-16, 21 and 26 ^{0}C. The study yielded surface temperature 47.623^0C to 63.480^0C as outlined in table 3.

Table.3: Trombe wall surface temperature

		Factor 1	Factor 2	Factor 3	Response
Std	Run	A:Solar Radiation	B:Brooder Room Temp	C:Brooder Inlet Temp	Trombe wall o/s Temp
		Wh/m^2/day	^{0}C	^{0}C	^{0}C
11	1	590	24	26	60.552
4	2	640	34	21	58.480
3	3	540	34	21	52.623
9	4	590	24	16	50.552
17	5	590	29	21	55.552
14	6	590	29	21	55.552

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1	7	540	24	21	52.623
13	8	590	29	21	55.552
10	9	590	34	16	60.552
12	10	590	34	26	60.552
15	11	590	29	21	55.552
2	12	640	24	21	58.480
5	13	540	29	16	47.623
16	14	590	29	21	55.552
7	15	540	29	26	57.623
8	16	640	29	26	63.480
6	17	640	29	16	53.480

The analyses showed a linear relationship amongst solar radiation, trombe wall surface temperatures and the optimal brooding temperatures as shown in tables 4 to 10and summarized in equation (7).

Table 4: Model summary -test of equation type.

Response	**2**	**Tr wall o/s Temp**	**Transform:**	**None**	
Summary (detailed tables shown below)					
	Sequential	**Lack of Fit**	**Adjusted**	**Predicted**	
Source	**p-value**	**p-value**	**R-Squared**	**R-Squared**	
Linear	0.0005		0.6762	0.4556	Suggested
2FI	0.1954		0.7313	0.1636	
Quadratic	0.2375		0.7825	-0.5225	
Cubic			1.0000		Aliased

Table 5: Model summary –Sum of squares

Sequential Model Sum of Squares [Type I]						
	Sum of		**Mean**	**F**	**p-value**	
Source	**Squares**	**df**	**Square**	**Value**	**Prob> F**	
Mean vs Total	53578.89	1	53578.89			
Linear vs Mean	193.61	3	64.54	12.14	0.0005	Suggested
2FI vs Linear	25.00	3	8.33	1.89	0.1954	
Quadratic vs 2FI	19.12	3	6.37	1.78	0.2375	
Cubic vs Quadratic	25.00	3	8.33			Aliased
Residual	0.000	4	0.000			
Total	53841.62	17	3167.15			

Table 6: Model summary- Lack of fit tests

Lack of Fit Tests						
	Sum of		**Mean**	**F**	**p-value**	
Source	**Squares**	**df**	**Square**	**Value**	**Prob> F**	
Linear	69.12	9	7.68			
2FI	44.12	6	7.35			
Quadratic	25.00	3	8.33			
Cubic	0.000	0				
Pure Error	0.000	4	0.000			

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Table7: Model summary

Model Summary Statistics						
	Std.		**Adjusted**	**Predicted**		
Source	**Dev.**	**R-Squared**	**R-Squared**	**R-Squared**	**PRESS**	
Linear	2.31	0.7369	0.6762	0.4556	143.02	Suggested
2FI	2.10	0.8321	0.7313	0.1636	219.76	
Quadratic	1.89	0.9048	0.7825	-0.5225	400.00	
Cubic	0.000	1.0000	1.0000		+	Aliased

Table 8: Analysis of variance for surface wall temperatures

ANOVA for Response Surface Linear model						
Analysis of variance table [Partial sum of squares - Type III]						
	Sum of		**Mean**	**F**	**p-value**	
Source	**Squares**	**df**	**Square**	**Value**	**Prob> F**	
Model	193.61	3	64.54	12.14	0.0005	significant
A-Solar Radiation	*68.61*	*1*	*68.61*	*12.90*	*0.0033*	
B-Brooder Room Temp	*12.50*	*1*	*12.50*	*2.35*	*0.1492*	
C-Brooder Inlet Temp	*112.50*	*1*	*112.50*	*21.16*	*0.0005*	
Residual	69.12	13	5.32			
Lack of Fit	*69.12*	*9*	*7.68*			
Pure Error	*0.000*	*4*	*0.000*			
Cor Total	262.73	16				

Table 9- Standard deviation

Std. Dev.	2.31		R-Squared	0.7369
Mean	56.14		Adj R-Squared	0.6762
C.V. %	4.11		Pred R-Squared	0.4556
PRESS	143.02		Adeq Precision	11.942
-2 Log Likelihood	72.09		BIC	83.42
			AICc	83.42

Table 10:Equation of the model

	Coefficient		**Standard**	**95% CI**	**95% CI**	
Factor	**Estimate**	**df**	**Error**	**Low**	**High**	**VIF**
Intercept	56.14	1	0.56	54.93	57.35	
A-Solar Radiation	2.93	1	0.82	1.17	4.69	1.00
B-Brooder Room Temp	1.25	1	0.82	-0.51	3.01	1.00
C-Brooder Inlet Temp	3.75	1	0.82	1.99	5.51	1.00

Final equation interms of coded factors

Trombe wall surface temperature = 56.14 +2.93*A +1.25*B +3.75*C …..…….. (7)

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Where A- Solar radiation, B-Brooder room temperature and C-Brooder inlet temperature

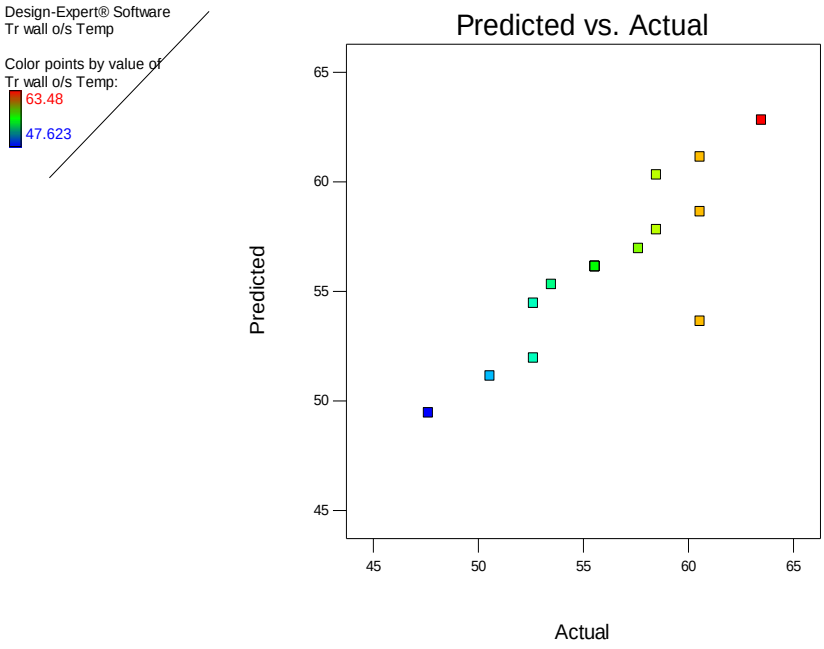

Fig.2. Relationship between actual and predicted figures

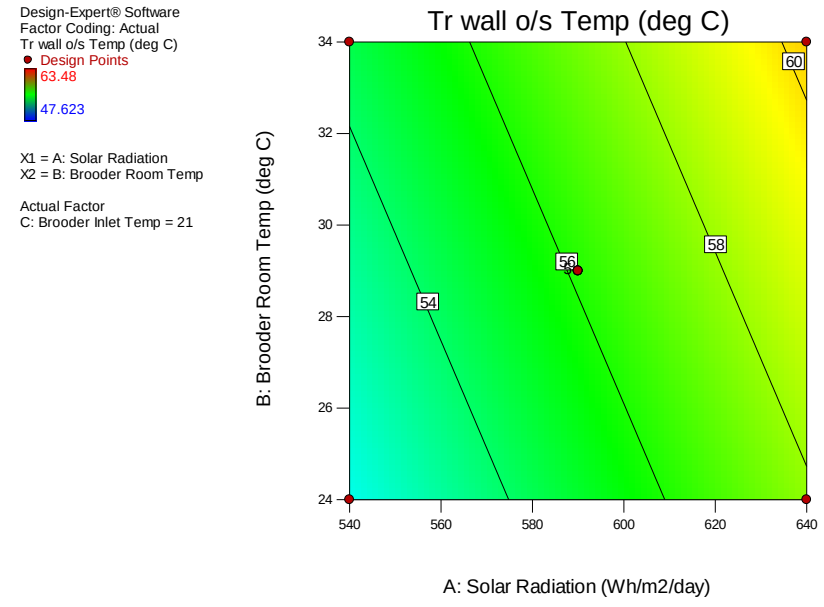

Fig 3. Contour of Solar radiation,Brooder & wall temp

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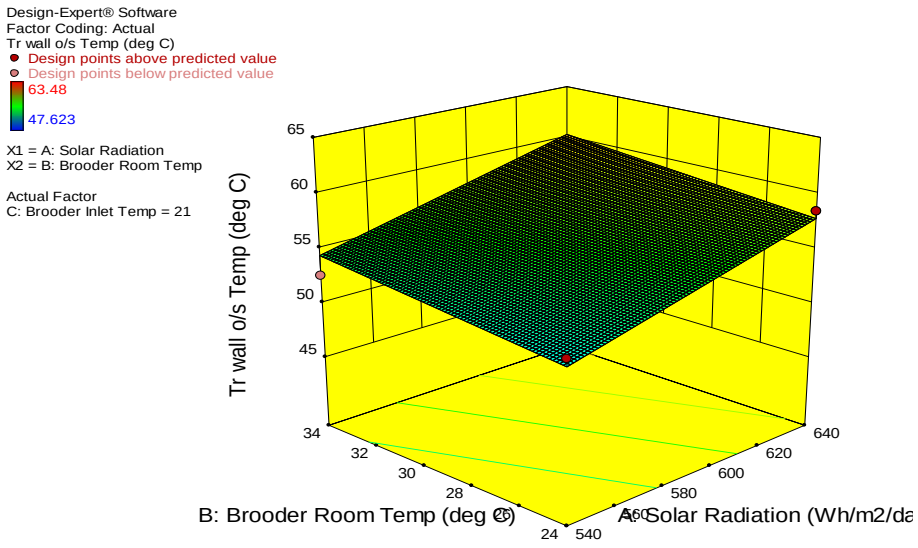

Fig. 4. 3-D for Solar radiation, Brooder temperature and brooder wall surface temperature.

IV. CONCLUSION

A brooder constructed of a brick trombe wall and wooden slatted floor can be used to raise chicks since the internal brooder temperatures developed by simulation were within the optimal brooding temperatures for chicken i.e 24 ^{0}C to 34 ^{0}C. There is a linear relationship amongst solar radiation, trombe wall surface temperatures and the optimal brooding temperatures.Thus, Trombe wall surface temperature = 56.14 +2.93*solar radiation+1.25*brooder room temprature +3.75*brooder inlet temperature.

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Assessment of Heavy Metals in Philippine Green Mussels *Perna viridis* and Level of Coliform on Manila Bay Adjacent to the Coastline of Sipac Almacen, Navotas Philippines

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***Abstract*—** *There have been no published data reports up to date regarding the heavy metal concentration on both the green mussels Perna viridis and total coliform level from Manila bay adjacent to Sipac Almacen, Navotas Philippines. Hence, this study aimed to provide a recent status on the concentration of heavy metals (Cd, Cr, Pb, and Hg) in the muscular tissues of P. viridis and coliform level from Manila Bay, Philippines. Specimen samples were collected on February 22, 2019, almost 1000 m away from the coastline, immediately brought to the laboratory, morphologically identified, dissected for muscles, and subjected to heavy metal and coliform testing. Tissue samples of P. viridis and sediment samples from Manila bay were subjected to Flame-AAS (atomic absorption spectrophotometry) method for detecting and quantifying heavy metals such as total cadmium (Cd), total chromium (Cr), and total lead (Pb) while the analysis of total mercury (Hg) were done using the Cold Vapor-AAS method. With reference to a previous study, the sediment and P. viridis from this study obtained a lower total Cd, Cr, and total Pb while total Hg concentration is below the resulting limit. The water sample was subjected to multiple fermentation technique to identify the coliform level which shows a high-level result of 1.6 X 103 that is far from the 3000 value set by DAO 2016-08 for SB water body category. The physicochemical analyses on the bay show no value of ecological concern. P. viridis in Manila Bay did not exhibit any serious deformities*

***Keywords*— Manila Bay, heavy metal, Portunus pelagicus, AAS, pollution.**

I. INTRODUCTION

Navotas is popularly known as the fishing capital of the Philippines. It has a total land area of 10.77 km^2. It is considered as a coastal town in the northwest part of Metro Manila. It is a tapering strip of land with an aggregated shoreline of approximately 4.5 km. In the north, Navotas has a common boundary with the town of Obando, Bulacan, along Sukol Creek which separates it from Balt. Along the eastern border runs the Binuangan River, the Daang Cawayan River, the Dampalit River, the Batasan River, the Navotas River, the Bangculasi Channel, the Malabon Channel and the Estero de Maypajo (PSGC 2018).

Navotas river is the major channel in the city of Navotas. It Intersects with Tullahan river that drains water from Navotas, Caloocan, and Malabon and dumps water directly to Manila bay adjacent to the coastline of Sipac Almacen Navotas, Philippines.

Navotas city is a highly urbanized city in Metro Manila (Census of Population (2015), and has a population of 249,463 people (Census of Population (2015). Informal settlers are generally those who occupy lands without the consent of the property owner (Reyes et al 2012, 15).

Informal settlers living in the coastline of Sipac Almacen, Navotas facing Manila bay area are families of the fishermen, fish vendors in the fish port, fish porters and skippers (bangkero). In Manila, they are commonly called as urban poor. However, not all of them are poor because they have an occupation to pay bills. Poor sanitary discipline was observed in the area, no appropriate toilets that dispose of human wastes, many biodegradable and non-biodegradable wastes found uncontrollably floating on the water near the residential area. Since Sipac Almacen is a residential area that is across the breakwater when it is high tide water mixes with the Navotas river which presumably the cause of the high level of coliform. Approximately, 400 m away from the coastal area of Sipac Almacen, Navotas facing Manila Bay,

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a number of docked Cargo ships and Fishing vessels were commonly found along the Manila Bay. Some of the cargo ships and fishing vessels were drydocked for repair. Presumably, the crews of the shipping vessels and cargo ships dumped liquid wastes in the Manila Bay. Thus, a high possibility for heavy metal contamination.

According to Table 2 DAO 2016-08 of Water Quality Guidelines and Effluent Standards of 2016 of Water Body Classification and Usage of Marine Waters, Manila bay falls under the classification of SB, wherein it states that this water body is suitable for commercial propagation of shellfish and spawning areas of milkfish and similar species, it serves as ecotourism and recreational activities spot.

Perna viridis is commonly found at the tropical and subtropical regions and reproduce rapidly even at extreme conditions like polluted harbours or bays just like on the results of the study of Rajagopal et al. (1997, 1998b) where very high densities of *P. viridis* have been reported from polluted harbours and submarine pipelines of coastal power stations. With this special reproduction behaviour of the *Perna viridis,* a lot of local fishermen invest on culturing it on the coastal area of Sipac Almacen, Navotas Philippines even if there are a lot of cargo ships, vessels, and informal settlers.

Culturing mussels at the intertidal zone of Sipac Almacen, Navotas is a common scenery. *Perna viridis* is not only part of their meal plan likewise it is a source of income for local fishermen. Due to increasing prices of the basic commodities at the Philippines, people look for food source which has a high nutritive value but on a cheaper price like *Perna viridis*. *Perna viridis* is rich in amino acids, vitamins A, B_1, B_2, B_3, B_6, B_{12}, and C. It is likewise rich on both macro and micro mineral contents. The macro mineral calcium, potassium, sodium and iodine were found to be high. Magnesium and iron were significantly detected in meager level. Trace metals like zinc and copper were in trace level (Saritha 2015).

The Aim of the Study

It is better to understand that metal test is very crucial in interpreting the quality of water, that is why the very aim of this study is to assess the quality of water using Perna viridis as a biological indicator and sediment samples as recipient of different depository materials from numerous anthropogenic sources on Manila Bay for metal test and to determine the level of coliform in the coastline of Sipac Almacen facing Manila Bay area.

Significance of the Study

This research is significant to the locals of Navotas, Caloocan, and Malabon to ensure the quality of water on Manila Bay performs its top ecosystem service that is a habitat for various marine life organisms, for example, Perna Veridis as a staple food for the people of Navotas, Caloocan, and Malabon. As to date, this is the only research study done in Manila Bay Adjacent to Sipac Almacen Navotas, Philippines.

II. MATERIALS AND METHODS

On February 5, 2019, an initial site analysis was conducted in Manila Bay Adjacent to Sipac Almacen Navotas Philippines, to determine if the water and the biological indicator Philippine Green Mussels Perna viridis is possibly contaminated with coliform and heavy metals.On February 22, 2019, 10:00 AM sample collection was conducted in Manila Bay Adjacent to the coastal area Sipac Almacen, Navotas Philippines approximately 14’34’’15.20° N 120’56’’31.85° E. Samples were collected, stored in a cooler, and immediately brought to the laboratory for processing.

Specimen samples were morphologically identified through www.sealifebase.org (Poutiers 1998). Samples for analysis were dissected, and muscular tissues were obtained for heavy metal testing. Tissue samples were subjected to Flame AAS (atomic absorption spectrophotometry) method for detecting and quantifying heavy metals such as total cadmium (Cd), total chromium (Cr), and total lead (Pb) following the standard procedures from AOAC International 19th ed. 2012. The analysis of total mercury (Hg) was done using the Cold Vapor-AAS method in reference to AOAC International 19th ed. 2012. All heavy metal analysis was performed at the F.A.S.T Laboratories Cubao, Quezon City, Philippines.

Sediments sample were collected and submitted immediately to the Laboratory for Metal test. Cold vapor AAS was used to test the presence of Mercury. Flame AAS was used to test the presence of the metals Cadmium (Cd) Chromium (Cr) and Lead (Pb) in reference to AOAC International 19th ed. 2012. 4500- O C. Azide Modification was used to determine the dissolved oxygen, argentometric for examining the salinity, 4500- H+ B electrometry/ 2550 B Laboratory and field was used to determine the Ph/ Temperature, 2120 B visual comparison for examining the color and 2130 B. Nephelometric was used to determine the turbidity of the water sample. All these tests and procedures in reference to APHA AWWA and WEF 2012/2017 Standard Method for the Examination of Water and Wastewater 22nd and 23rd Edition. Multiple Tube Fermentation Technique (MPN/100ml) was used to determine the coliform level of the water sample in reference to APHA AWWA and WEF 2012/2017 Standard Method for the Examination of Water and Wastewater 22nd and 23rd Edition.

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Description of the Sampling area

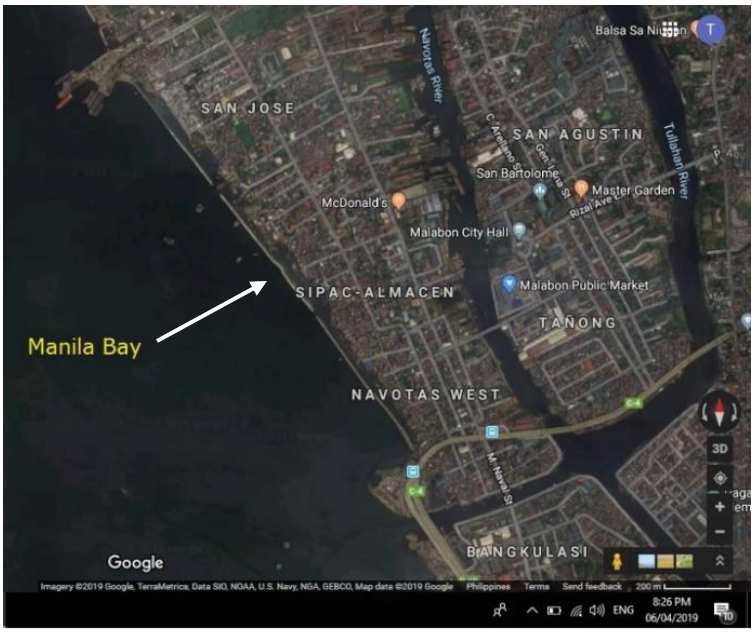

Fig.1: Geographic satellite view of the Manila bay Adjacent to Sipac Almacen, Navotas Philippines. Google Earth 2019.

On figure 1 shows the geographic satellite view of Manila Bay adjacent to the residential area of Sipac Almacen Navotas Philippines is bounded with two tributaries namely Navotas river and Tullahan river. With the coordinates, approximately 14’34’’15.20°N 120’56’’31.85° E. Number of huge docked ships for repair is commonly observed in the area. Fishing vessels are in abundance in line with business activities at the coastline area of Sipac Almacen Navotas. Informal settlers are seen at the very edge of the coastline of Sipac Almacen Navotas facing Manila Bay.

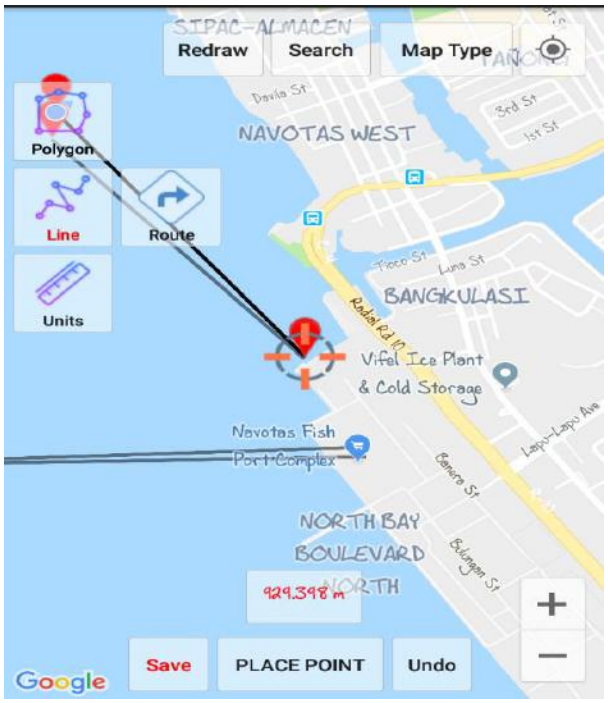

Fig.2: Sampling site. 929.398 m away from the coastline of the Bangkulasi Navotas, Philippines. (we begin the Line transect at Bangkulasi due to boats are docked at Bangkulasi not in Sipac Almacen). Google Earth 2019.

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On figure 2 it shows the sampling site with its line transect from the original point that measures 929.398 from the coast of Bangkulasi Navotas. It should be noted here that we begin our transect line measurement from Bangkulasi not in Sipac Almacen Navotas due to the boats are docked in Bangkulasi Navotas not in Sipac Almacen Navotas.

III. RESULTS AND DISCUSSION

Table 1. Analysis on the physicochemical primary parameters of water sample at Manila Bay Adjacent to Sipac Almacen, Navotas Philippines

Primary Parameters	Unit	DAO 2016-08 Water Quality Guidelines for Primary Parameters	This Study
DO	mg/L	6	3.2
Turbidity	NTU	NA	2.1
PH/Temperature	/0°C	7.0-8.5	7.9@25.0°C
Color	TCU	50	15@7.9
Salinity	NTU	35	35.2

APHA AWWA and WEF 2012/2017 Standard Method for the Examination of Water and Wastewater 22nd and 23rd Edition. F.A.S.T Laboratories. PAB Accredited Testing Laboratory PNS ISO/IEC 17025:2005

Water quality guidelines shall be maintained for each water body classification. (DAO 2016-08). For this purpose, primary and secondary parameters are set to monitor water quality. On table 1, it shows the comparative analysis between the primary parameters set by DAO 2016-08 and from the water sample obtained from the Manila bay adjacent to Sipac Almacen Navotas, Philippines. The dissolved oxygen on the site is much lower than standards set by DAO 2016-08 which can be attributed to few to none at all presence of planktons, algae and other plant-related organisms that dwell in the study site. Lower oxygen count on the body of water indicates that life is threatened in the area and is not in optimal health. Presence of water pollutants will lower the DO considerably as a result of organic matter discharges (Chapman, 1996). Turbidity is an expression of the optical property that causes lightweight materials to be scattered and absorbed rather than transmitted with no alteration in direction or flux level through the sample. The Higher the turbidity the higher is the dissolved substances such as clay, mud, silt and even microorganism that refracts the light(APHA AWWA and WEF 2012/2017). In the study site, a lower value of turbidity indicates that there is a lower density of solid substances and microorganisms that refract the light. The PH level of the water is still within the standards set by DAO 2016-08. While its color is lower than the set standards of DAO 2016-08 which can be attributed to the wastes dumped by informal settlers and even from docked ships and vessels at the coastlines. While its salinity is likewise on the average range of typical saline water having a salinity of 35 ppt.

Table.2: Total coliform count on water sample from the Manila bay Adjacent to sipac Almacen Navotas Philippines.

Sample	Effluent Standards DAO 2016-08 CLASS SB water body category	Multiple tube fermentation technique most probable number (MPN) per 100 mL **TOTAL COLIFORM COUNT**
Sea water from Manila Bay adjacent to Sipac Almacen Navotas	3×10^3	16×10^3

APHA AWWA and WEF 2012/2017 Standard Method for the Examination of Water and Wastewater 22nd and 23rd Edition. F.A.S.T Laboratories. PAB Accredited Testing Laboratory PNS ISO/IEC 17025:2005

On table 2, it shows a highly significant value of coliform present in the water at the study site that can be attributed to the number of informal settlers and their voluminous sewage and domestic wastes dumped directly to the Manila Bay. Fecal coliforms under the group of coliform are used as a mean by which scientists determine if the water is being

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contaminated by sewage. Sewage contains bacteria, viruses and other organisms (collectively referred to as pathogens) that can cause disease in humans such as typhoid fever, hepatitis, gastroenteritis, and dysentery (PEMSEA 2006).

Table.3: Heavy metal assessment in the water of Manila bay Adjacent to Sipac Almacen Navotas, Philippines.

Heavy metal	Permissible limit	Sia Su et.al (2009) bivalve mollusks *Mercenaria sp*. Mollusks Hard clam	This study 2019 bivalve mollusks *Perna veridis* Green mussels
Cd	1.0 [a], 2.0 [b]	1.7214[ab]	Less than 0.005[y]
Cr	0.100	9.54525[ab]	Less than 0.25[y]
Pb	1.5	7.3833[ab]	Less than 0.30[y]
Hg	0.5	No data	Less than 0.30 [y]

[a]Commission Regulation (EC) No/ 1881/2006 by EU; [b]Maximum Levels of Contaminants in Foods (GB 27622012) by MHPRC.
[a] Measured mean total heavy metal concentrations that exceeded the permitted level
[b] Highest mean total concentration for each heavy metal
[y] reporting limit. F.A.S.T Laboratories. Reference. Official method of analysis of AOAC International.

On table 3, it explains that the turbid state of Manila bay resulting from docked ships and fishing vessels, organic and inorganic wastes from anthropogenic sources provides a habitat for sessile organism *Perna viridis*. The means by which filter feeders like mussels acquire their food may also be the same route in which contaminants such as heavy metals enter the body tissues of *P. viridis*. In filter-feeding bivalves like mussels, particulate matters in the ocean are carried in suspension by currents of water pumped through their incurrent siphon, across the gills, then out to the excurrent siphon (Putri, 2012). Results shows that particles greater than 4 μm (including tiny organisms, detritus, suspended sediment, and chemical contaminants) are completely retained by the cirri. They are entangled with mucus then assimilated, or passed through the body without being digested depending on the size, shape, and other physical characteristics of that particle (Jorgensen 1996). This characteristic of *P. viridis* made them resistant to metals and other contaminants.

Although as depicted on the assessment of metals present on mussels, such as cadmium, chromium, lead and mercury is within the permissible limit this does not follow that the water in the area is not contaminated and is conducive for other marine species. This could only suggest that *P. veridis* has a great bioaccumulation capability within an extreme conditions of high level of heavy metals present in the water (Nacua 2018).

Heavy metals such as lead, chromium, cadmium and mercury can be generated as waste from electroplating, nickel plating, smelting, engraving, batteries, sewage sludge, fertilizers, paints, pigments, plastics and waste disposal yard (Alloway and Ayres, 1997; Manahan, 2001; Bagchi, 2004; Cumar and Nagaraja, 2011; Galarpe and Parilla, 2014) while Deposition of Cd may be associated to anthropogenic sources (Velasquez et al., 2002).

However, even if the results of metal assessment in the *Perna viridis* shows that it is within the permissible limit, metal assessment on the sediments of Manila bay shows otherwise on Table 4.

Table.4: Comparative analysis between heavy metal assessment on sediments found in Cansaga bay Cebu, Philippines and Manila bay Adjacent in Sipac Almacen Navotas, Philippines.

Parameters	Cansaga bay Cebu Philippines, 2017	This study 2019
Pb	0.0947	39
Cd	2.2231	0.117
Cr	17.3171	3.64
Hg	Nd	Less than 0.005[y]

[y] reporting limit. F.A.S.T Laboratories. Reference. Official method of analysis of AOAC International.

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Like Manila bay, Cansaga bay is located in the metropolitan district and is home to heavily industrialized city in the northeast coastline part of Cebu . Presence of heavy metals are likewise observed in the turbid Cansaga bay, however result shows on table 4 indicates that there is a significant high value of difference on Lead contamination in Manila bay than in Cansaga Bay. This is due to number of docked ships on Manila bay. The high concentration of lead may cause of neurological deficits such as mental retardation in children and kidney disease such as interstitial nephritis to adults. It also contributes to hypertension and cardiovascular disease to the consumers in the coastal areas after long term consumption (Hossen 2015). Although cadmium and chromium present in Cansaga bay display a higher value than Manila bay this can be attributed to the type of industry that dumps cadmium and Chromium specifically industries that uses and burn coal to produce steam (Kimbrough1999) as a waste product in the bay. Mercury assessment results present in Manila bay indicates that it is within the permissible limit.

Table.5: Heavy metals in Manila bay adjacent to Sipac Almacen Navotas, Philippines compared to threshold quality guidelines from different sources

SQG	HEAVY METALS mg/kg				Reference
	Cd	Cr	Pb	Hg	
Manila Bay	0.117	3.64	39	less than 0.005[y]	This study
TEL[a]	0.6	37.3	35	Nd	Macdonald et.al 2000
ERL[b]	5	80	35	Nd	Macdonald et.al 2001
LEL[c]	0.6	26	31	Nd	Macdonald et.al 2002
MET[d]	0.9	55	42	Nd	Macdonald et.al 2003
NOAA ERL[e]	1.2	81	47	Nd	NOAA 1999
HONGKONG ISQG-low[f]	1.8	80	75	Nd	ANZECC 1997

Threshold Sediment Quality Guidelines from Different Sources. Galarpe et.al. (2017)
Threshold effect level, [b]effects range low, [c]lowest effect level, [d]minimal effect threshold, [e]National Oceanic and Atmospheric Administration, [f]Hong Kong-interim sediment quality guideline.

With respect to the threshold quality guidelines of sediments from different sources by Galarpe et.al (2017), the heavy metal assessment of sediment from this study is under the permissible value. Although they exhibit significant value than the one exhibited by the results in the *Perna viridis*, it is still within the permissible range. The mercury range of the sediment is still on the permissible value.

IV. CONCLUSION

Perna viridis in Manila Bay was observed for not having any serious deformities and signs of visceral necrosis with its gross morphology intact and concurring with published descriptions and values. It has been assessed that it has tolerable levels of Cd, Cr, Pb, and Hg with reference to international/national standards. With reference to the previous similar study done in Cansaga Bay Cebu, Philippines, this study obtained a lower total Cd, Hg, Pb and Cr both in sediments and the P. viridis but higher in terms of total coliform level in reference to DAO 2016-08. This study is the first attempt to measure total Hg in P. viridis in Manila Bay but the concentration obtained is below the detectable limit. It is recommended to have a follow-up monitoring of heavy metals in fish and shellfish commodities in Manila Bay as the influx of industrial and anthropogenic wastes to the bay is becoming extensive (DAO2016-08 table 2-3).

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DECLARATION OF CONFLICT OF INTEREST

I the correspondent author declare that there is no conflict of interest for this paper entitled Assessment of Heavy Metals in Philippine Green Mussels *Perna viridis* and Level of Coliform on Manila Bay Adjacent to the Coastline of Sipac Almacen, Navotas Philippines. And I hereby address to the set rules and regulations mandated by this publication.

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DATA AVAILABILITY (SUPPLEMENTARY MATERIALS)

Conducted and verified results by FAST LABORATORIES, Cubao Quezon City Philippines be submitted on a separate file on a pdf format.

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Workplace Bullying in Private Companies in the Philippines: Major Cause of Employee Burnout

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Abstract*— *This study was conducted to determine the existence of workplace bullying in private companies in the Philippines as major cause of employee burnout. The study utilized descriptive method of research having 100 respondents from different private companies. Respondents are equally divided into female and male. Structured questionnaire was the main instrument of the study during the survey conducted.

Most of the respondents interviewed were between 18 to 22 years old. There were 4 variables considered in describing how may bullying evaluated in terms of; injustice, destructive behavior, obstruction to achieve work target and work autonomy. The majority of the male respondents are saying that the bullying inside the workplace was particularly happens when someone's using abusive language. On the other hand, most of the female respondents are saying that it happens when unreasonable work load is given. The majority of the male respondents are saying that the destructive behavior inside the workplace happens when they are the repeatedly target of superior's ire while most of the female respondents are saying that it happens when they are the repeatedly target of superior's ire and if they are threatened to remove from work. The majority of the male and female respondents are saying that the obstruction to achieve work target will prevent if reasonable work is given. The majority of the male and female respondents are saying that the work autonomy happens if the job will be performing with atleast supervision.

There is a significant relationship between the age of the respondent and their evaluated experiences in bullying. Significant relationship between the sex of the respondent and their evaluated experiences in bullying. The possible programs & policies for companies to solve the existing bullying in the workplace.

***Keywords*— *employee burnout, employee welfare, private companies in the Philippines, workplace bullying*.**

I. INTRODUCTION

Life is an odd mixture of different moments of action and inaction, work and rest.(Harees, 2012)Business Dictionary defined work is a job and as something that should be done to earn money. Work means saving the person from the dullness and boredom of life. It puts our energies to a proper use. Unuseenergies create disorders in us. Consequently, Work can make people physically unhealthy and mentaly unhappy. Indeed, work can provides us with money for livelihood, part of it is use to sustain our daily basic needs in life for our family and education; furthermore, it can help us to contribute in our community itself.(Harees, 2012)

Violence is a form of storm causes great fear to others. Business Dictionary defined violence as a physical force unlawfully exercised toward property or persons, causing damage or injury. Hence,many Filipinos face bullying at work.(Bullying, 2016) Although workplace bullying is not a popular topic of conversation, it is quite rampant in countries all over the world. (The World's Authority on Bullying, 2015)

According to Workplace bullying institute, Workplace Bullying consist of three basic types of abuse - emotional, verbal and physical.It typically involved subtitle methods of coercion such as threatening, humiliating, or work intimidating, work interference, sabotage which prevents work from getting done, or abuse. However, Workplace bullying can be defined in many different ways. According to the (Workplace Bullying Institute, 2016) "The victim of bullying is sometimes referred to as a target"

Several studies indicate that Office bullying or Workplace bullying is similar to School bullying but not the same.In some cases, it is called Workplace harassment, some countries bullying incidents are referred to minors and harassment to adults. In the Philippines we use bullying for both minors and adults. (Santos, 2014)Therefore, any form of harassment or abuse, in the workplace, may negatively impact to the mental and physical health of an employee.(Einarsen, Hoel,Notelaers, 2009)

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In 2013, President Aquino Benigno S. 3rd signed into Law Republic Act No. 10627, or the Anti Bullying Act of 2013. Thus, the Law mandates all elementary and secondary schools and learning centers in the Philippines to adopt Anti-Bullying Policy. However, Bullying does not end when one graduates from school. Bullying exist in the workplace and there is no current law to address that matter. The closest to it that have present is House Bill No. 815, or the Anti Bullying Act of 2016, which was filed in the House of Representative by RodelBatocabe and Christopher Co of Partylist Group. "Ako Bicol" in the 17th Congress.

Even though there is no universally accepted definition of workplace bullying, the researchers aim to explore the effects of workplace bullying in selected companies in Nueva Ecija. Therefore, one of the main objectives of this study is to give the business firms an idea on how to avoid this type of situation in order to have an effective and efficient working environment.

Based on the content mentioned above, these are the reasons of the researchers to conduct this study. The said study may bring significant impact to the companies for them to formulate programs that will protect their workers from bullying.

1.1 Literature Survey

Workplace bullying

Work is a defining factor in a person's life, identity, and well being. Therefore, some researchers have indicated that the experience of being bullied at work has devastating immediate and long-term consequences, especially for the victims or targets of this behavior (Roscigno, Lopez,&Hodson, 2009) Moreover, several studies have shown that negative emotions, psychological symptoms, commonly result from bullying at work, and target's emotional injuries typically persist long after the bullying experiences has ended (Einarsen, Hoel, &Notelaers, 2009;Roscigno, Lopez, Hodson, 2009)

While,there is no single universally accepted definition of workplace bullying,there is a general agreement among researchers that this phenomenon is an experience of repeated and persistent negative acts toward one or more individuals, in a work-related environment. (Lewis,Sheehan,& Davies, 2008; Einarsen, Hoel, Notelaers, 2009; Roscigno, Lopez, &Hodson, 2009)

Workplace Bullying has two main categories:

Researchers indicate stated that workplace bullying has two main categories which are shape upon. One of these categories is **work-related bullying**, which are unwanted repeated actions and practices that are directed to one or more workers**.** (Wilkes,& Vickers 2008) It may cause humiliation, distress, and that may interfere with work performance and create an unpleasant working environment. Work-related bullying behaviors may include an unachievable task, impossible deadlines, unmanageable workloads, meaningless task or supplying unclear information, threat about security etc. (Hutchinson et al.,2008)

The Other category is **person-related bullying** which is regarded as a form of stress that is capable of causing negative effects on employees health, probably leads to psychological symptoms, psychiatric trouble such as anxiety-depression disorders, chronic adjustment disorder and post-traumatic stress disorder. Person-related bullying behaviors are ignoring, insulting public humiliation, spreading rumors or gossips, and intruding on privacy,yelling etc. (Ramsay T. B., 2010)

Causes and effects of Workplace Bullying

These bullying experiences usually occur over prolonged periods of time and include behaviors such as constant criticism, gossip, blaming, and social exclusion, to name a few (Roscigno, Lopez, &Hodson, 2009; Olender-Russo, 2009). Interestingly, as with many forms of workplace aggression, bullying may begin as psychological harassment but ultimately escalate into physical acts of violence or abuse.

Several researchers have indicated that workplace bullying typically involves a perceived power imbalance, and that this behavior often ultimately results in a harmful and unhealthy work environment (Lewis, Sheehan,& Davies,2008;Roscigno,Lopez,& Hodson,2009). In fact, Some studies have also demonstrated that, in most cases, the target of bullying is a relatively powerless worker who often lacks the resources or ability to defend oneself (Olender-Russo,2009) For instance, incidents of bullying have been shown to decrease the morale, productivity and general work-quality of the bullied and non-bullied workers, within an organization (Roscigno, 2009)This negative behavior is also capable of significantly impacting the overall success of an organization due to factors such as high rates of employee absenteeism and turn over(Lewis,Sheehan,& Davies,2008; Baillien, Neyens, De Witte,& De Cuyper,2009). Indeed, studies have shown that bullying is a common reason for why some workers leave jobs, especially within their first year of employment, thereby significantly increasing the costs of employment, increasing the costs of organizational

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recruiting, hiring and training (Simons, 2008;Lewis, Sheehan,& Davies,2008; Olender-Russo, 2009).

Further Literature Review

Similar to the literature, Wiedmer (2011) defines workplace bullying as repetitive negative behavior to one or more persons. Examples of workplace bullying are: verbal abuse, offensive conduct which can be perceived as threatening or hostile, and actions which prevent an employee from completing their work.

However, Survey research indicates that workplace bullying is a predictor for anxiety and depression as well as job dissatisfaction, turnover and absenteeism. Results indicate that those individuals who were bullied may also become bullies themselves. Situational factors such as work conflicts also resulted in bullying behavior. (Hauge, Skogstad; & Einarsen 2010)

Some Researchers recommend that management develop anti-bullying policies. (Glaso, Matthiesen, Nielsen&Einarsen2010) focused on whether there was a typical personality profile for bullied employees. Their research indicates that those individuals who were more likely to be bullied were characterized as more anxious and neurotic, less extroverted, less organized and less dependable.(De Cuyper, Baillen& De Witte 2009) survey research examined the relationship between the job stressor, job insecurity, and workplace bullying. Hence, Some Research in the field of workplace bullying has mainly focused on psychological and behavioral perspective. The causes to why people bully others and outcomes for the ones exposed to the bullying-like stress or work efficacy-have been explored. (Berry et al, 2012).

1.2. Objectives of the Study

This study was conducted to determine the existence of workplace bullying in private companies in District IV of Nueva Ecija. Specifically, the study has the following objectives:

1. Describe the respondents' profile in terms of age and sex.
2. Determine the existing forms of bullying in terms of:
    a. Injustices;
    b. Destructive behavior;
    c. Obstruction to achieve work target; and
    d. Work autonomy.
3. Determine if there is significant relationship between the age of the respondents and their evaluated experiences in bullying.
4. Determine if there is significant relationship between the sex of the respondents and their evaluated experiences in bullying.
5. Identify the possible programs and policies for companies to solve the existing bullying.

1.3. Hypotheses

Ho: 1. There is no significant relationship between the age of the respondents and their evaluated experiences.

Ho: 2. There is no significant relationship between the sex of the respondents and their evaluated experiences.

II. MATERIALS AND METHODS

2.1 Method Used

The study was a descriptive research in which the primary aimed was to describe the phenomena happening on selected private companies in District IV of Nueva Ecija. Descriptive method is the most appropriate method since it describes with emphasis what actually exist such as current conditions, practices situations, or any phenomena.

2.2. Research Locale

Municipalities in District IV of Nueva Ecija served as the location of the study. Specifically, municipalities of Jaen, San Isidro, San Antonio, Cabiao, San Leonardo, Gapan, Penaranda and Gen. Tinio.

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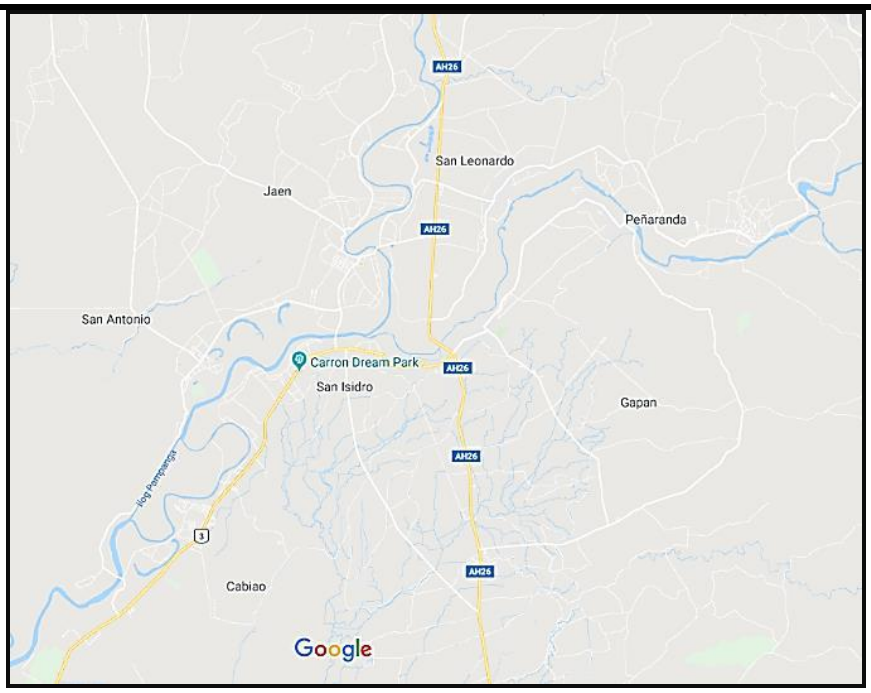

Fig.1: Location of the Study (District IV of Nueva Ecija)

2.3. Respondents of the Study

The respondents of this study came from the selected supermarkets in District IV of Nueva Ecija. The target respondents were 100 workers in District IV of Nueva Ecija. Respondents were equally divided in terms of age, 50 male and 50 female.

There were 10 private companies subjected in the study which the industry they belong was assumed to be irrelevant in the study. There were five (5) male and five (5) female respondents in each company participated in the study.

2.4. Sampling Techniques

The researchers used quota sampling in selecting the respondents of the study. This is the most appropriate method since the researchers were able to ensure equal or proportionate representational of subjects depending on which trait was considered as basis of the quota.

2.5. Instrument of the Study

The main instrument of the study was a structured questionnaire. Which the researchers were able to ensure the validity of the instrument so that it will measure what it intends to measure in accordance to the objectives of the study.

The step was conducted the intensive review of related literature and studies to familiarize the researchers on the main problem of the study. After the review of related literature and studies, the researchers was construct the instrument in accordance to the objectives of the study.

2.6. Techniques in Gathering Data

The researchers used techniques in gathering the needed data and it was in the form of survey, interview, focus group discussion and documents & record collection. Statistical Treatment utilize frequency count and percentage.

Survey – composed of six parts, namely, injustice, destructive behavior, obstruction to achieve work target, and work autonomy.

Interview– this was conducted by the researcher in District IV of Nueva Ecija that has employees who are currently involve into workplace bullying.

Focus Group Discussion (FGD)- A focus group discussion (FGD) is a good way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest. The group of participants is guided by a moderator (or group facilitator) who introduces topics for discussion and helps the group to participate in a lively and natural discussion among themselves.

Documents & Record Collection – With the use of records and information from data, the researchers gathered factual data for creating the questionnaire.

2.7. Data Analysis Tools

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The researchers used two (2) statistical tools to facilitate the ease analysis and interpretation of data. Frequency of distribution and percentile was used to describe the respondents of the respondents in their age and experience bullying in terms of injustices, obstructive behavior and work autonomy.

Furthermore, Kruskal-Wallis was used to determine the correlation of age and sex to experiences relating to workplace bullying of the respondents. This is a non-parametric tool can determine the relationship between identified variables if the total population was not stated and respondents were selected using non-probability sampling. Since the researchers were not able to determine the total population and respondents were selected using quota sampling (non-probability sampling).

III. RESULTS AND DISCUSSION

3.1. Demographic Profile of the Respondents

Table 1. Demographic Profile of the Respondents

Demographic Profile	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Age of the Respondents				
18-22	11	22%	24	48%
23-27	24	48%	18	36%
28-32	13	26%	5	10%
33-37	0	0%	1	2%
38-42	1	2%	0	0%
43 and above	1	2%	2	4%
Total	50	100%	50	100%
Sex	50	100%	50	100%

Table 1 shows the demographic profile of the respondents. Out of 50 male respondents, 24 or 48% of them are 23-27 years of age, and 0 or 0% of them are 33-37 years of age. On the other hand, out of 50 female respondents, 24 or 48% of them are 18-22 years of age, and 0 or 0% of them are 38-42 years of age.

3.2. Experienced Workplace Bullying in the Workplace

3.2.1. Injustices

Injustice	Yes						No					
	Male		Female		Total		Male		Female		Total	
	f	%	f	%	F	%	f	%	f	%	f	%
1.Promotion is based on merit	14	28%	19	38%	33	33%	36	72%	31	62%	67	67%
2.Unreasonable work load is given	21	42%	28	56%	49	49%	29	58%	22	44%	51	51%
3.Using abusive language	25	50%	24	48%	49	49%	25	50%	26	52%	51	51%
4.Excluded from receiving benefits	8	16%	10	20%	18	18%	42	84%	40	80%	82	82%
5.Treated with intimidation	16	32%	18	36%	34	34%	34	68%	32	64%	66	66%

As can be gleaned on table 2 regarding Experienced Workplace Bullying in the Workplace "Injustices", The highest items who answered yes with 49 or 49% were 2 "Unreasonable work load is given" and 3 "Using abusive language", and the lowest item who answered yes with 18 or 18% was 4 "Excluded from receiving benefits". On the other hand, the highest item who answered no with 82 or 82% was 4 "Excluded from receiving benefits", and the lowest items who answered no with 51 or 51% were 2 "Unreasonable work load is given" and 3 "Using abusive language".

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3.2.2. Destructive Behavior

Destructive Behaviour	Yes						No					
	Male		Female		Total		Male		Female		Total	
	f	*%*	*f*	*%*	*F*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
1. Repeatedly the target of superior's ire	36	72%	32	64%	68	68%	14	28%	18	36%	32	32%
2. Repeatedly shouted upon by my boss	28	56%	22	44%	50	50%	22	44%	28	56%	50	50%
3. Harassed for unknown reason	17	34%	21	42%	38	38%	33	66%	29	58%	62	62%
4. Humiliation for slight mistake committed	27	54%	28	56%	55	55%	23	46%	22	44%	45	45%
5. Threatened to remove from work	34	68%	32	64%	66	66%	16	32%	18	36%	34	34%

As can be seen on table 3 regarding Experienced Workplace Bullying in the Workplace "Obstructive behavior", The highest items who answered yes with 68 or 68% was 1 "Repeatedly the target of superior's ire", and the lowest item who answered yes with 38 or 38% was 3 "Harassed for unknown reason". On the other hand, the highest item who answered no with 62 or 62% was 3 "Harassed for unknown reason", and the lowest item who answered no with 32 or 32% was 1 ".Repeatedly the target of superior's ire".

3.2.3. Obstruction to Work

Obstruction to achieve to work target	Yes						No					
	Male		Female		Total		Male		Female		Total	
	F	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
1.Reasonable work load is given	47	94%	44	88%	91	91%	3	6%	6	12%	9	9%
2. Enough time is given to submit documents	43	86%	43	86%	86	86%	7	14%	7	14%	14	14%
3.Support systemis provided to accomplish tasks	41	82%	39	78%	80	80%	9	18%	11	22%	20	20%
4.Vital information regarding work output is available	42	84%	41	82%	83	83%	8	16%	9	18%	17	17%
5.Work assignment is based on field of specialization	44	88%	41	82%	85	85%	6	12%	9	18%	15	15%

As can be shown on table 4 regarding Experienced Workplace Bullying in the Workplace "Obstruction to work", The highest items who answered yes with 91 or 91% was 1 "Reasonable work is given", and the lowest item who answered yes with 80 or 80% was 3 "Support System is provided to accomplish tasks". On the other hand, the highest item who answered no with 20 or 20% was 3 "Support System is provided to accomplish tasks", and the lowest item who answered no with 9 or 9% was 1 ".Reasonable work is given".

3.2.4. Work Autonomy

Work Autonomy	Yes						No					
	Male		Female		Total		Male		Female		Total	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
1.The job will be performing with atleast supervision	46	92%	47	94%	93	93%	4	8%	3	6%	7	7%

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2.There is freedom to determine work performance	39	78%	40	80%	79	79%	11	22%	10	20%	21	21%
3.There is freedom to choose how and when working assignment is to be done	41	82%	37	74%	78	78%	9	18%	13	26%	22	22%
4.Superior determines what to teach to their employees	44	88%	43	86%	87	87%	6	12%	7	14%	13	13%
5.My superior is output oriented rather than procedure oriented	44	88%	43	86%	87	87%	6	12%	7	14%	13	13%

As can be noticed on table 5 regarding Experienced Workplace Bullying in the Workplace "Work Autonomy", the highest items who answered yes with 93 or 93% was 1 "The job will be performing with atleast supervision", and the lowest item who answered yes with 78 or 78% was 3 "There is freedom to choose how and when working assignment is to be done". On the other hand, the highest item who answered no with 22 or 22% was 3 "There is freedom to choose how and when working assignment is to be done", and the lowest item who answered no with 7 or 7% was 1 "The job will be performing with atleast supervision".

3.3. Relationship of Age to Experienced Workplace Bullying

Experiences	Correlation	Verbal Interpretation
1. Injustice		
a. Promotion is based on merit	0.09	Weak positive Correlation
b. Unreasonable work load is given.	0.01	Weak positive correlation
c. Using abusive language	0.17	Weak negative correlation
d. Excluded from receiving benefits.	0.01	Weak negative correlation
e. Treated with intimidation.	0.17	Weak negative correlation
2. Destructive Behavior		
a. Repeatedly the target o superior's ire.	-0.03	Weak negative correlation
b. Repeatedly shouted upon by my boss.	0.02	Weak positive correlation
c. Harassed for unknown reason.	-0.04	Weak negative correlation
d. Humiliation for slight mistake committed.	0.01	Weak positive correlation
e. Threatened to remove from work.	0.07	Weak positive correlation
3. Obstructions to achieve work target		
a. Reasonable work load is given.	0.14	Weak positive correlation
b. Enough time is given to submit documents.	-0.16	Weak negative correlation
c. Support system is provided to accomplish task's.	0.06	Weak positive correlation
d. Vital information regarding work output is available.	-0.03	Weak negative correlation
e. Work assignment is based on filled of specialization.	-0.03	Weak negative correlation
4. Work Autonomy		
a. The job will be performing with at least supervision.	-0.01	Weak negative correlation
b. There is freedom to determine work performance.	0.02	Weak positive correlation
c. There is freedom to choose how and when working assignment is to be done.	0.08	Weak positive correlation
d. Superior determine what to teach their employees.	0.13	Weak positive correlation
e. My superior is output oriented rather than procedure oriented.	0.09	Weak positive correlation

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Table 6 shows that Relationship of Age to Experienced Workplace Bullying in terms of injustice, destructive behavior, obstruction to achieve work target, and work autonomy had -0.01 to 0.17 correlation with the verbal interpretation of "Weak positive correlation".

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Factors Affecting Laborers' Productivity in the Construction Companies

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Abstract**—** *The purpose of this research paper is to determine factors affecting the productivity of laborers in construction companies in Nueva Ecija, Philippines. The researchers find this important especially to big construction industries, as it will able to guide them in hiring the best people for the job. The methodology used in this research is a descriptive-survey with questionnaire as the main instrument answered by both the laborers and their supervisors who served as respondents of this study. The study found out that the productivity of the laborers sometimes exceeds standards or expectations which implied that they have advanced knowledge in their work. Further, age and monthly compensation were the two main factors that affected their productivity which was an indication that mature laborers with higher monthly income were more productive employees.*

Keywords**— Business, construction companies, laborers, monthly income, productive employees.**

I. INTRODUCTION

A prosperous construction project has countless essential components. One of those is the laborers. Laborers play a very significant role in the construction business from the onset of the task to its completion within a specified time; that is why their productivity should be observed. Productivity can be defined in many ways. In construction, productivity is usually taken to mean labor productivity; that is, units of work placed or produced per man-hour [1]. Laborers productivity determines the ability of the construction to meet its customers demand and financial objectives. A noncompliance workforce may put the construction company in jeopardy and will entail extra operational cost.

"Some factors affecting labor productivity or the performance of individual work roles include individual attitudinal, motivational and behavioral factors, individual rewards and payment systems [2]". Understanding critical factors that affect laborers productivity can help develop strategies that are easy and efficient way [3] to reduce inefficiencies and to effectively manage construction labor force. This will not only improve the project performance of construction companies but also make them more competitive.

Similarly, the workers' productivity affected the overall worth of the job and the task. The necessity for productivity was perhaps more important in the construction sector compared to any other sector. "It was necessary to implement, as far as possible, industry-wide principles of production throughout the construction process for managers to make accurate decisions given available information [4]". Though, it was known that careful adaptation would be required to implement the knowledge and experience gained in the manufacturing industry to the building construction industry [5] as cited in [6].

In the Philippines, the construction industry employs workers with different types of occupations, from licensed professionals and executives to unskilled workers. Traditionally the construction industry took a significant portion of employment for many countries all around the world. The authors in [7] "explored various factors affecting laborers productivity such as lack of materials, delay in the arrival of material, unclear instruction to laborers, laborers strikes, financial difficulties, higher absenteeism of laborers, no supervision method, supervisors absenteeism, lack of equipment and design change. However, some others factors to be considered is in the side of laborers like; poor health conditions, working without taking a holiday or rest day and drinking habits. These may consider major concerns for any construction and profitable business and should be addressed immediately if they want to have more chance of becoming successful [8]".

At present, construction projects are usually covered by a Memorandum of Agreement or Contract containing the details and description of the project including the payment schedule, cost, and timelines for the completion of the project both agreed by the contractor and the customer. In some cases, there are delays in the progress of the project due to lacking equipment's, availability of materials, incomplete legal requirements, poor quality, overhead and high cost of wages of laborers and weather condition. The

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costs of these interruptions may perhaps end in a severe loss of money for the contractor. Proper work planning and smart tools will enable work planners to identify, quantify, reduce, and eliminate the possible causes of delays in the project, hence improving the productivity and will stay on the agreed budget. Thus, this study was conceptualized. It determined the productivity of the laborers and factors affecting the productivity so that contractors and owners can effectively plan the operations and finished projects on time to reduce unnecessary costs because of delay. This action is beneficial to contractors and owners since it can continuously help them in developing and improving their problem solving and critical thinking skills [9] which are needed for them to thrive in this kind of business.

II. METHODOLOGY

This study utilized the descriptive-correlational research design to determine the factors affecting the laborers' productivity in the three selected construction companies in Nueva Ecija, Philippines. According to [10], as cited in [11], "Correlational research is employed to test the degree of relationship between two variables".

The main instrument used in this study was a questionnaire composed of two parts. Part 1 outlined the respondents' profile in terms of age, civil status and educational attainment and Part 2 consisted of a checklist designed to assess the factors that affect laborer's productivity towards their work. Frequency, percentage, weighted mean, Spearman's rho, and Pearson's r were used in analyzing the gathered data.

Random sampling was used to choose 70 respondents of this study.

The respondents were asked to choose one rating opposite each description on a scale of 1 to 5 (see Table 1), where five (5) is the highest point and one (1) as the lowest.

Table 1. Scale for the Productivity of the Laborers

Scale	Rating	Description
5	Excellent/ Outstanding	The productivity exceeds standards or expectations / Has mastered the skills and can train others
4	Above Average	The productivity Sometimes exceeds standards or expectations / Has advanced knowledge
3	Satisfactory	The productivity Meets standards or expectations / Can perform effectively without the supervision
2	Fair/Must Improve	The productivity Sometimes fall below standards or expectations / Can perform with close supervision
1	Poor/Unsatisfactory	The productivity Often fall below standards or expectations / Has basic knowledge

III. RESULTS AND DISCUSSION

1. Profile of the Respondents

The average age of the laborers in the three (3) constructions companies ranges from 20 years to 39 years old or basically at the middle age. This indicates that construction companies prefer to hire young laborers. As to the laborers' educational attainment, most of them are high school levels or high school graduates. Moreover, most of them are married with a monthly salary amounting to more or less Php10,000.00 per month and with less than ten years of experience in the construction industry.

2. The productivity of the Laborers as described by them and their Supervisors

Table 2. Productivity of the Laborers

	Laborers	*Supervisors*		
PRODUCTIVITY	***WM***	***WM***	**Average**	**VD**
1. Knowledge of the job	4.01	3.77	3.89	AA
2. Quality, Neatness, Accuracy	3.86	3.79	3.83	AA
3.Expediting work under pressure	3.57	3.56	3.57	AA
4.Interpersonal Relations	3.94	3.79	3.87	AA
5.Initiative and interest	3.91	3.83	3.87	AA
6.Exercising judgment	3.67	3.61	3.64	AA
7.Ability to accept innovations and changes	3.99	3.87	3.93	AA

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8.Communication: Verbal and written	3.44	3.41	3.43	AA
9.Observance of company's rules and regulations	3.81	3.87	3.84	AA
10. Customer and co-workers relations	3.69	3.67	3.68	AA
11. Dependability	3.74	3.7	3.72	AA
12. Attendance	4.31	3.99	4.15	AA
OWM	3.83	3.74	3.79	AA

Productivity, as described by the laborers and supervisors, resulted in an overall weighted mean of 3.79 with a verbal interpretation of above average. This means that the productivity of the laborers sometimes exceeds the standards or expectations. They particularly exceed expectations with their attendance and their ability to accept innovations and changes. This further implies that the respondent-laborers are punctual and are responsible and open-minded, flexible and adaptive individuals.

3. Significant Difference in the Responses of the Two Groups regarding the Productivity of the Laborers

Table 3. Comparison of the Responses as to the Productivity of the Laborers

Productivity of the Laborers	***Supervisors***	***Laborers***
Mean	3.74	3.83
Variance	0.0245	0.0531
t Stat	-1.140 Ns	
t Critical two-tail	2.074	

Ns = no significant difference

The null hypothesis of no significant difference in the responses of the two groups of respondents is accepted since the t-Stat is less than t Critical two-tail. This result implies that the two groups of respondents have similar views regarding the productivity of the laborers.

4. Significant Relationship between the Profile of the Laborers and their Productivity

Table 4. Relationship between the Profile and the Productivity of the Laborers

	PRODUCTIVITY		
Profile	***correlation value***	***p-value***	***Interpretation***
Age	.306**	.010	Significant relationship
Civil Status	.230	.055	No significant relationship
Years of Experience	.144	.234	No significant relationship
Nature of Work	-.208	.084	No significant relationship
Highest Educational Attainment	.173	.153	No significant relationship
Monthly Income	.312**	.009	Significant relationship

*Legend: ** correlation is significant @ 0.01 level*

Age and monthly income are significantly related to productivity. This means that those mature laborers with higher monthly income are more productive employees of the business.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the result and analysis of the given data, the researchers concluded that: The age of laborers in the construction business is range from 20 to 39 years of age. Most of them reached high school level and high school graduate, and more than 70% of them are married. The majority had less than ten years in construction work experience. The laborers' self-assessment and their supervisors' assessment of 3.83 and 3.74, respectively, both fell under the Above Average rating. Hence, there is no significant difference in the rating of the two groups of respondents regarding the productivity of the laborers. Further, age and monthly income are the major factors related to the productivity of the laborers in the construction business.

It is recommended that in hiring laborers, the owner of the construction business must take into consideration the age and salary scale to be given to them. Also, a periodic assessment both by the laborer and his superior must be conducted during the construction period to test their productivity and ensure the quality of work.

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Energy Audit and Heat Recovery on the Rotary Kiln of the Cement Plant in Ethiopia: A case study

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Abstract— *This study deals with the energy audit and heat recovery on the rotary kiln taking a cement factory in Ethiopia as a case study.The system is a dry type rotary kiln equipped with a five stage cyclone type preheater, pre-calciner and grate cooler. The kiln has a capacity of 2,000 tons/day.Mass and energy balance has been performed for energy auditing. The energy lost from the kiln shell is about 4.3 MW. By using secondary shell on the rotary kiln about 3.5MW could be recovered safely.This energy saving reduces fuel consumption (almost 9%) of the kiln system, and increases the overall system efficiency by approximately 2–3%.*

Keywords— Rotary kiln; Energy audit; Heat recovery; Secondary shell.

I. INTRODUCTION

Cement production is an energy consuming process and requires about 4 GJ per ton of cement product. In order to produce one ton of clinker at least 1.6 GJ heat is needed [1]. However, now days, it is about averagely2.95 GJ energy is consumed per ton of cement for advanced kilns, but in some countries, the consumption exceeds 5 GJ/ton. For example, the average energy requirementof Chinese key plants to produce clinker is 5.4 GJ/ton [2].

The energy audit is the most effective procedures for good and well energy management program [3]. The main purpose of energy audits is to give an accurate account of energy requirement and use analysis of different components and to provide the detailedinformation needed for determining the possible opportunities for energy conservation. There are potential ways to improve overall kiln efficiency likewaste heat recovery from hot gases and hot kiln surfaces[3,4]. However, it is difficult to make a detailed thermal analysis of rotary kiln systems in the open literature. This study focuses on the energy audit and heat recovery of a horizontal rotary kiln system, by usingMessebo Cement Plant line-1 in Ethiopia. First a detailed thermodynamic analysis of the kiln system is made and then, mechanismof heat recovery from the kiln shell heat loss sources are discussed.

II. PLANT AND PROCESS DESCRIPTION

Rotary kilns are refractory lined tubes and have a diameter up to 6 m. Rotary kilns are generally rotates with a speed of1–2rpm and inclined at an angle of $3–3.5^0$. By using cyclone type pre-heaters raw materials are preheated before enters the kiln intake. Pre-calcination is started in the pre-heaters, and almost one third of the raw material would be pre-calcined at the end of pre-heating in the current dry rotary kiln system[5].

The physical appearance of our rotary kiln is refractory lined tubes with a diameter of 3.8m and 57 m length and has a capacity to produce 2,000 tons/day. It is dry process rotary kiln equipped with five stage cyclone preheaters and pre-calciner kilns and grate coolers. The system of the cement production mainly includes following steps:

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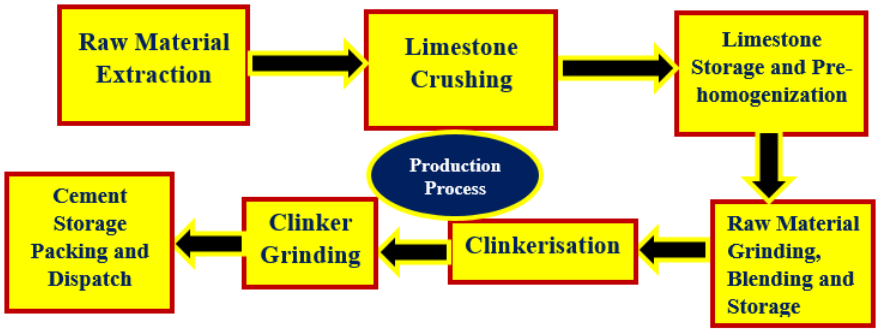

Fig.1: The overview of cement production process

III. THERMODYNAMIC ANALYSIS AND HEAT RECOVERY OF ROTARY KILN

3.1 Assumptions

The following assumptions are made toanalyze the rotary kiln thermodynamically

a) The systemis steady state, steady flow and open.

b) Ambient temperature are constant throughout the study i.e. T_0 = 297K.

c) The composition of raw material and coal material and feed rate of both are constant.

e) The velocity of atmospheric air is < 3 m/s.

f) The temperature of kiln shellis constant throughout the study.

g) Consider the gases inside the kiln as an ideal gas.

3.2 Mass Balance

It is usually more convenient to define mass/energy data per kg clinker produced per unit time.

Table.1: Raw materials and clinker components and their percentages

Component	Raw Material (%)	Clinker (%)
SiO_2	13.4	21.1
Al_2O_3	3.2	4.08
Fe_2O_3	2.4	4.01
CaO	42.35	66.44
MgO	1.71	2.42
SO_3	0.4	1.15
K_2O	0.27	0.5
Na_2O	0.09	0.3
H_2O	0.01	---
Organics	0.8	---
Ignition loss	35.4	---
Total	100	100

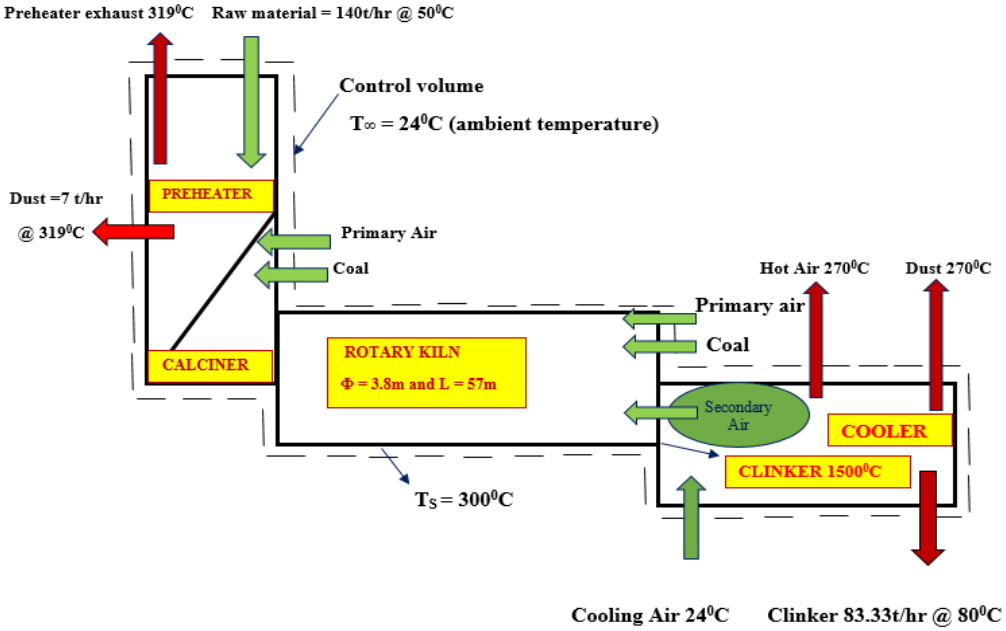

Fig.2: Control volume, various streams and components for kiln system.

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3.3 Energy Balance

Based on the collected data,the energy balance is applied to the kiln system. By using Zur-Strassen equationthe energy used for clinker formation can be found [6,7].

Clinker formation energy = $17.196(Al_2O_3) + 27.112(MgO) + 32(CaO) - 21.405(SiO_2) - 2.468(Fe_2O_3)$

By using Dulong's formula the GCV (Gross Calorific Value) of the coal is found [8].

GCV = 337 x C + 1442 (H – O/8) + 93 x S

Table.2: Percentage composition of Coal

Element Content	Percentage (%)
C	73
H	3.5
O	6
N	1.75
S	1.59
Ash	3.01
Moisture	0.309
Volatile	4.67
Fixed Carbon	9.05

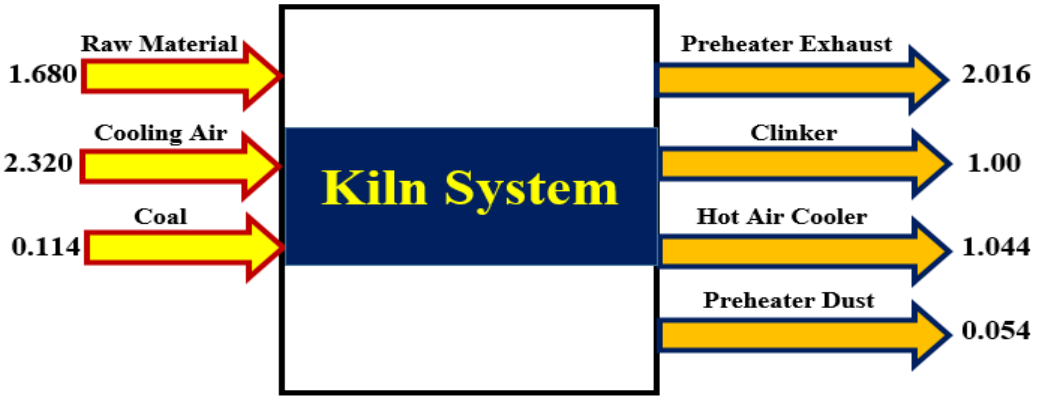

Fig.3: Mass balance of the kiln system.

Note: All the above data are taken from CCR (Central Controlling Room) from Messebo Building Material Production (MBMP) Line-I, Mekelle (Ethiopia) when the plant is under working condition by using averages and interpolation.

Heat Inputs

1. Combustion of Coal (95.22%)
   $Q_1 = M_c$ H_c= 3358.25 kJ/kg-clinker M_c=0.114kg/kg-clinker H_c=29,458.32kJ/kg
2. Sensible heat by coal (0.19 %)
   $Q_2 = M_c$ H_c= 6.9 KJ /kg-clinker, H_c= CT C=1.15kJ/kg^{0}C T=50^{0}C
3. Heat by Raw material (2.05%)
   $Q_3 = M_{Rm}H_{Rm}$ = 72.24 kJ /kg-clinker, H_{Rm}= CT C=0.86kJ/kg^{0}C T=50^{0}C
4. Organics in the kiln feed (0.54%)
   $Q_4 = FKh_{or}$= 18.93 kJ /kg-clinker, F=0.10, K=0.009, h_{os} =21,036 kJ/kg (Ref. [6])
5. Heat by cooling air (2%)

$Q_5 = M_{ca}H_{ca}$ = 70.5 kJ /kg-clinker, H_{ca} = 30 kJ/kg

6. Total heat inputs
   $Q_T = \sum_{i=1}^{5} Q_i$= 3526.82kJ/kg (100%)

Heat Outputs

1. Kiln exhaust gas (19.53%)
   $Q_6 = M_{ex}C_{ex}T_{ex}$= 688.76kj/kg-clinker C_{ex} =1.071 kJ/kg^{0}C, T =319^{0}C
2. Heat loss by dust (0.42%)
   $Q_7 = M_D h_D$= 14.85kj/kg-clinker $h_{dust;ave}$= 275 kJ/kg (Ref. [6])
3. Hot air from cooler (16.22%)
   $Q_8 = M_{Ha}h_{Ha}$= 571.87kj/kg-clinker h_{Ha}=547.77kJ/kg(@T=270^{0}C)
4. Clinker discharge (2.02%)
   $Q_9 = M_{clinker}h_{clinker@80^0C}$ = 71.09kj/kg-clinker
5. Clinker formation (51.04%)
   Q_{10}=1800kj/kg-clinker
6. The combined effects of conduction, convection and radiation on the kiln shell is calculated below and has the heat lost from kiln surface (5.27%)
   Q_{11}=4.3MW=185.94kj/kg-clinker
7. Radiation from pre-heater surface (0.23%)
   $Q_{12} = \sigma \varepsilon A_{ph}(T_s^4 - T\infty^4)/1000M_{clinker}$ = 8.11kj/kg-clinker

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σ=5.67 *10^{-8} W/m^2 K^4, ε=0.78, A_{ph} =264m^2, T_{PHs} =393K, T_∞=297K,

8. Natural convection from pre-heater surface (0.3%)
   $Q_{13}=h_{ncon}A_{ph}(T_s-T\infty)/1000M_{clinker}$ = 10.61kj/kg-clinker
   $h_{ncon}=K_{air}*Nu/L_{ph}$; Ra=5.35*$10^{13}$, Nu=0.1$(Ra)^{1/3}$ Nu=3768.06 (Ref. [8]), T_f=72^{0}C (film temp.)
9. Radiation from cooler surface (0.11%)
   $Q_{14}=\sigma\varepsilon A_c(T_s^4-T\infty^4)/1000M_{clinker}$=3.8kj/kg-clinker
   σ=5.67 *10^{-8} W/m^2 K^4, ε=0.78 (oxidized surface, Ref. [8]), A_C=144m^2, T_{Cs} =383K, T_∞=297K, $M_{clinker}$ =23.15kg/s
10. Natural convection from cooler surface (0.07%)
    $Q_{15}=h_{ncon}A_c(T_s-T\infty)/1000M_{clinker}$ = 2.6kj/kg-clinker
    $h_{ncon}=K_{air}*Nu/L_C$, Ra=7.89*10^{12}, Nu=0.1$(Ra)^{1/3}$ Nu=1991, L_C =12, T_f=67^{0}C(film temp.)
11. Moisture in raw material and coal (0.69%)
    $Q_{16}=m_{water}(h_{fg@50^0C}+h_{g@319^0C}-h_{g@50^0C})$=24.41kj/kg-clinker
    $h_{fg@50^0C}$=2384kj/kg, $h_{g@50^0C}$=2591kj/kg, $h_{g@319^0C}$=2700kj/kg, m_{water}= 0.0098kg/kg-clinker
12. Unaccounted heat losses (4.1%)
    Q_{17}=144.78kj/kg-clinker
13. Total heat output
    $Q_T=\sum_{i=1}^{17}Q_i$=3526.82kj/kg-clinker (100%)

The heat is transferred from the rotary kiln shell to the surroundingdue to the temperature difference between inner and outersurface of the rotary kiln. This heat is transferred by three mechanisms such as conduction, convection and the radiation. These mechanismsare assumed as the heat loss that can be conserved somehow. The heat lost from the rotary kiln surface to the environment is determined from the following equation [9,10,11].

$Q_{total}=\frac{T_{in}-T_{out}}{R_{total}}$ where, $R_{total}=R_{cond\ I}+R_{cond\ II}+\frac{R_{conv}*R_{rad}}{R_{conv}+R_{rad}}$

$R_{cond}=\frac{\ln(\frac{r_{out}}{r_{in}})}{2\pi*l*k}$, $R_{conv}=\frac{1}{A*h}$, $R_{rad}=\frac{1}{A*E}$

Where:R_{total} is the total heat resistance,

A is the area of the rotary kiln = π x L x d while length of kiln is 57m and the diameter is 3.8m,

k is the thermal conductivity of bricks lining (2.7-1.5 W/mK) [12] and kiln shell (27 W/mK) [13],

h is the natural convective coefficient &E is the radiative heat transfer and is calculate below [10].

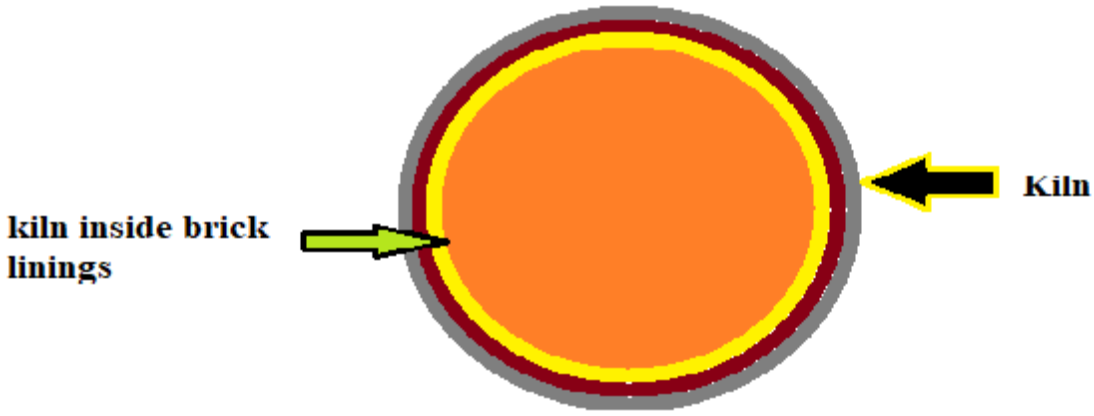

Fig.4: The rotary kiln transverse cross section

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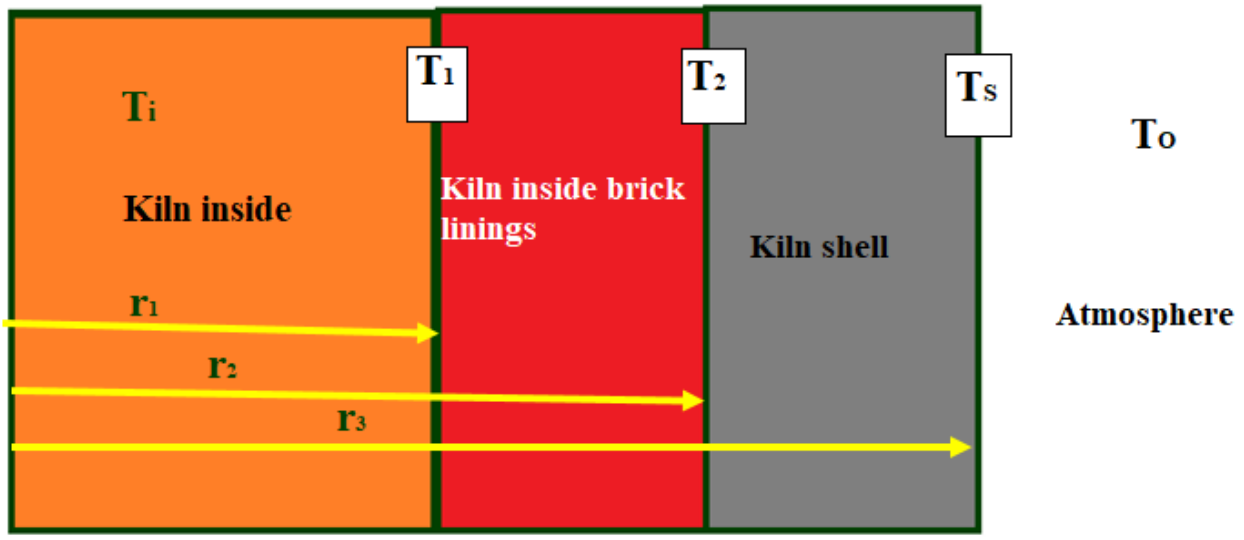

Fig.5: The rotary kiln shell longitudinal cross section

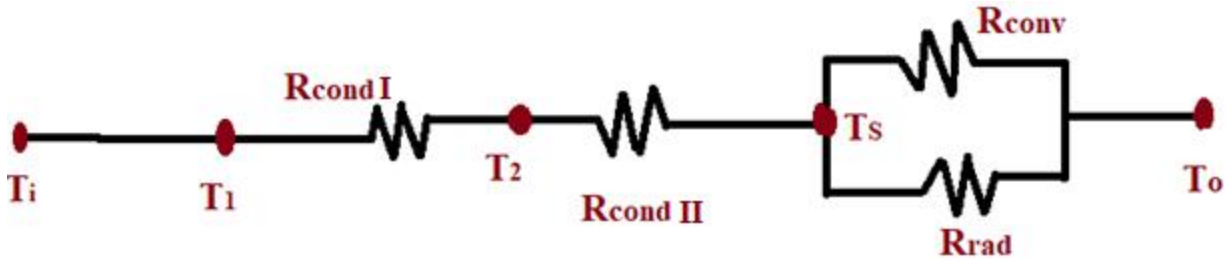

Fig.6: Kiln shell resistance equivalent circuit diagram

The heat transfers coefficient (h) and the heat flux (E) is given by:

$$h = \frac{Nu * K}{d}$$

$$E = \sigma * \varepsilon * F_{12} * (T_S{}^2 + T_O{}^2)(T_S + T_O)$$

Where, ε is the emissivity of the surface (0.78 for oxidized surface), and σ is Stefane-Boltzman constant as 5.67 x 10-8 W/m^2 K^4, F_{12} is View factor that takes (=1)and Nu is Nusselt number.

Consider the thickness of the shell and brick linings is 25mm and 100mm respectively; hence,

$R_{cond\ I} = \frac{\ln(\frac{r_2}{r_1})}{2\pi * l * k} = 56.67 * 10^{-60}$C/W

$R_{cond\ II} = \frac{\ln(\frac{r_3}{r_2})}{2\pi * l * k} = 1.37 * 10^{-60}$C/W

$R_{conv} = \frac{1}{A * h} = 7.66 * 10^{-60}$C/W since the film temperature Tf=1035K and then

$h = \frac{Nu * K}{d}$ =191.84W/m^2 ^{0}C where NU=0.59(Ra)$^{1/4}$

$R_{rad} = \frac{1}{A * E}$ =9.17 $* 10^{-60}$C/W; $E = \sigma * \varepsilon * F_{12} * (T_S{}^2 + T_O{}^2)(T_S + T_O)$= 16.03W/m^2 ^{0}C

$R_{total} = R_{cond\ I} + R_{cond\ II} + \frac{R_{conv} * R_{rad}}{R_{conv} + R_{rad}}$=65.11 $*$ 10^{-60}C/W

$Q_{total} = \frac{T_{in} - T_{out}}{R_{total}} = \frac{(300-24)\,0C}{65.11 * 10^{-60}\text{C/W}} \cong$4.3MW

IV. HEAT RECOVERY FROM THE KILN SYSTEM

The overall system efficiency is given by $\eta = Q_{10}/Q_{\text{Total input}}$ = 1800/3526.82 =0.5104 or 51.04% which is relatively low as compared to some kiln systems operating at full capacity that have an efficiency of 55% operated on the current dry process methodology. In order to improve the overallefficiency of the kiln system some of the heat losses should be recovered. The recoveredheat energy can be used for various purposes, like boilingof hot water as well aselectricity generation. There are some major heat losses butin this study we would like to recover the heat lost from rotary kiln surface by using secondary shell system due to effective cost and easy installation.

4.1. Heat recovery from kiln surface

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The heat loss through conduction, convection and radiation forced to account a waste energy of 4.3MW(5.27%) of the input energy. Hence, this heat losseffectively reduced byusing secondary shell on the kiln surface.In this case insulating the kiln surface is unnecessary since the kiln shellhave to be repeatedly seen by the controller to observe any local burning on the surface because ofrefractory loss inside the kiln. The workingprinciple of secondary shell system is shown in Fig. 7.

Consider our rotary kiln, D_{kiln} =3.8 m, and a diameter of D_{shell}=4.2 m. Hence;the distance between the kiln and shell is relatively small (40 cm), we have to estimate the temperature of the secondary shell which is close to the actual one i.e. T_2= 280^{0}C = 553 K. We have to selectgood secondary shellmaterial for our purpose. Stainless steel (AISI 316) is selected due to low surface emissivity and thermal conductivity. The heat transfer rate by radiation is determined by: [7,9]:

$$Q_r = \frac{A_{kiln}\sigma(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1-\varepsilon_2}{\varepsilon_2}\left(\frac{D_{kiln}}{D_{shell}}\right)} = 186\text{kW}$$

Where; σ=5.67 x 10-8 W/m^2 K^4, T_1=T_S=573K,ε_1 = 0.78 (for oxidized kiln surface) and ε_2 =0.35 (lightly oxidized stainless steel).

This heat lost is transferredto the secondary shell through the insulation. In order to determineinsulation thickness,considera reasonable temperature for the insulationouter surface.The thermal conductivityfor glass wool insulation, is taken as 0.04 W/mK. Hence, the insulation layer resistance is given by:

$$\text{Resistance of insulation} = \frac{\ln\left(\frac{D_{ins}}{D_{shell}}\right)}{2\pi L_{kiln} K_{ins}}$$

Considering a temperature difference of ΔT_{ins}= 250^{0}C (i.e. outer surface temperatureis 50^{0}C), D_{ins} can be determined:

$\Delta T_{ins} = Q * R_{ins}$

$$250^0\text{C} = 187000 * \frac{\ln\left(\frac{D_{ins}}{4.2}\right)}{2\pi * 57 * 0.04} = \quad D_{ins} = 4.285\text{m}$$

The insulation thicknessbecomes:

Thickness = D_{ins} -D_{shell} =85mm

Theconvective and radiative heat transfer would become highly reduced when the secondary shell is applied onto the kiln surface. This is due to very low temperature difference in the gap. Hence, the total energy savings due to the secondary shell would become:

4300 -186 = 4114kW

Hence, we conclude that by using secondaryshell on the current kiln surface could save at least 3.5 MW safely, that is 8.4% of the total input energy. This high amount of energy saving leads as to reduce fuel consumption (almost 9%) of the kiln system, and increases the overall system efficiency by approximately 2–3%.

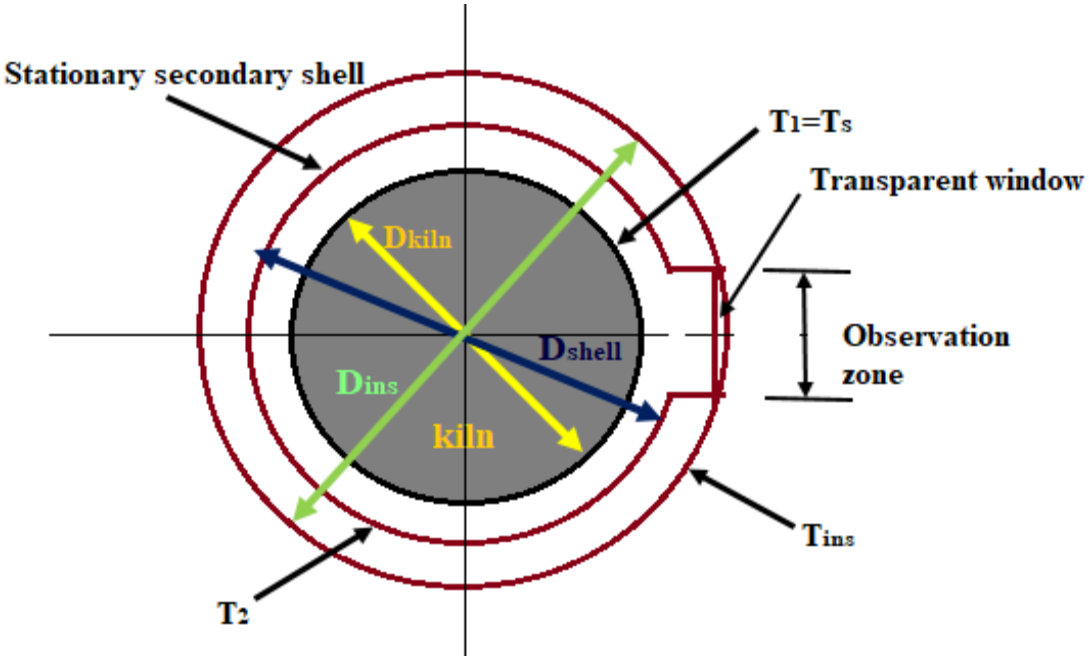

Fig.7: The working principle of Secondary shell to the current kiln surface.

V. CONCLUSION

It is found that the implementation of energy analysis on the rotary kiln is a very efficient and effective way for

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improving the efficiency of the kiln system and reduction of fuel consumption. There is some major energy lost with the hot gas through preheater andcooler stack is about 19.53% and is 16.22% of the energy input respectively. After using this energy into the pre-calcination and pre-heating although the out let temperature of the hot gas is very high. In this case an auxiliary circuit like WHRSG (Waste Heat Recovery Steam Generator) should be installed. In order to minimize the heat lost from the kiln shell,secondary shell system is applied and addedon to the kiln surface, the anzast layer inside the kiln bricks lining should have to be maintained and also the kiln surface should have to be painted for proper emissivity. By using these systems about 3.5 MW of energy is saved from the kiln surface which means 9% of the total input energy is recovered.Generally, in cement industry huge amount of energy is lost to the environment. Hence; there must be energy management department to study on the heat recovery system from the energy lost and on the alternative energy sources of the company.

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Multi Color Image Segmentation using L*A*B* Color Space

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Abstract— *Image segmentation is always a fundamental but challenging problem in computer vision. The simplest approach to image segmentation may be clustering of pixels. my works in this paper address the problem of image segmentation under the paradigm of clustering. A robust clustering algorithm is proposed and utilized to do clustering on the L*a*b* color feature space of pixels. Image segmentation is straight forwardly obtained by setting each pixel with its corresponding cluster. We test our segmentation method on fruits images, medical and Mat lab standard images. The experimental results clearly show region of interest object segmentation.*

Keywords— color space, L*a*b* color space, color image segmentation, color clustering technique.

I. INTRODUCTION

A Lab color space is a color-opponent space with dimension L for lightness and a and b for the color opponent dimensions, based on nonlinearly compressed CIE XYZ color space coordinates. The coordinates of the Hunter 1948 L, a, b color space are L, a, and b [1][2]. However, Lab is now more often used as an informal abbreviation for the CIE 1976 (L*, a*, b*) color space (also called CIELAB, whose coordinates are actually L*, a*, and b*). Thus, the initials Lab by themselves are somewhat ambiguous. The color spaces are related in purpose, but differ in implementation. Color spaces usually either model the human vision system or describe device dependent color appearances. Although there exist many different color spaces for human vision, those standardized by the CIE (i.e. XYZ, CIE Lab and CIE Luv, see for example Wyszecki & Stiles 2000) have gained the greatest popularity. These color spaces are device independent and should produce color constancy, at least in principle. Among device dependent color spaces are HSI, NCC rgbI and YIQ (see Appendix 1 for formulae). The different versions of HS-spaces (HSI, HSV, Fleck HS and HSB) are related to the human vision system; they describe the color's in a way that is intuitive to humans.

The three coordinates of CIELAB represent the lightness of the color (***L**** = 0 yields black and ***L**** = 100 indicates diffuse white; specular white may be higher), its position between red/magenta and green (***a****, negative values indicate green while positive values indicate magenta) and its position between yellow and blue (***b****, negative values indicate blue and positive values indicate yellow). The asterisk (*) after *L*, *a* and *b* are part of the full name, since they represent *L**, *a** and *b**, to distinguish them from Hunter's *L*, *a*, and *b*, described below. Since the *L*a*b** model is a three-dimensional model, it can only be represented properly in a three dimensional space. Two-dimensional depictions are chromaticity diagrams: sections of the color solid with a fixed lightness. It is crucial to realize that the visual representations of the full gamut of colors in this model are never accurate; they are there just to help in understanding the concept. Because the red/green and yellow/blue opponent channels are computed as differences of lightness transformations of (putative) cone responses, CIELAB is a chromatic value color space. A related color space, the CIE 1976 (*L**, *u**, *v**) color space (a.k.a. CIELUV), preserves the same *L** as *L*a*b** but has a different representation of the chromaticity components. CIELUV can also be expressed in cylindrical form (CIELCH), with the chromaticity components replaced by

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correlates of chroma and hue. Since CIELAB and CIELUV, the CIE has been incorporating an increasing number of colors appearance phenomena into their models, to better model color vision. These color appearance models, of which CIELAB, although not designed as [3] can be seen as a simple example [4], culminated with CIECAM02.

II. COLOR SPACE

The nonlinear relations for L*, a*, and b* are intended to mimic the nonlinear response of the eye. Furthermore, uniform changes of components in the L*a*b* color space aim to correspond to uniform changes in perceived color, so the relative perceptual differences between any two colors in L*a*b* can be approximated by treating each color as a point in a three dimensional space (with three components: L*, a*, b*) and taking the Euclidean distance between them [5].

A. Device independent color space

Some color spaces can express color in a device-independent way. Whereas RGB colors vary with display and scanner characteristics, and CMYK colors vary with printer, ink, and paper characteristics, device independent colors are not dependent on any particular device and are meant to be true representations of colors as perceived by the human eye. These color representations, called device-independent color spaces, result from work carried out by the Commission International d'Eclairage (CIE) and for that reason are also called CIE-based color spaces. The most common method of identifying color within a color space is a three-dimensional geometry. The three color attributes, hue, saturation, and brightness, are measured, assigned numeric values, and plotted within the color space.

*B. CIE XYZ to CIE L*a*b* (CIELAB) and CIELAB to CIE XYZ conversion*

The forward transformation

$$L^* = 116 f\left(Y/Y_n\right) - 16$$

$$a^* = 500\left[f\left(X/X_n\right) - f\left(Y/Y_n\right)\right]$$

$$b^* = 200\left[f\left(Y/Y_n\right) - f\left(Z/Z_n\right)\right]$$

where,

$$f(t) = \begin{cases} t^{1/3} & if\ t > \left(\frac{6}{29}\right)^3 \\ \frac{1}{3}\left(\frac{29}{6}\right)^2 t + \frac{4}{29} & otherwise \end{cases}$$

Here *Xn*, *Yn* and *Zn* are the CIE XYZ tristimulus values of the reference white point (the subscript n suggests "normalized").

The division of the $f(t)$ function into two domains was done to prevent an infinite slope at $t = 0$. $f(t)$ was assumed to be linear below some $t = t0$, and was assumed to match the $t1/3$ part of the function at $t0$ in both value and slope. In other words:

$$t_0^{1/3} = at_0 + b(matchinvalue)$$

$$\frac{1}{3}t_0^{-2/3} = a(matchinslope)$$

The slope was chosen to be $b = 16/116 = 4/29$. The above two equations can be solved for a and t_0:

$$a = \frac{1}{3}\delta^{-2} = 7.787037...$$

$$t_0 = \delta^3 = 0.008856...$$

Where $\delta = 6/29$ [8].Note that the slope at the join is $b = 4/29 = 2\delta/3$.

Reverse transformation

$$Y = Y_n f^{-1}\left(\frac{1}{116}\left(L^* + 16\right)\right)$$

$$X = X_n f^{-1}\left(\frac{1}{116}\left(L^* + 16\right) + \frac{1}{500}a^*\right)$$

$$Z = Z_n f^{-1}\left(\frac{1}{116}\left(L^* + 16\right) - \frac{1}{200}b^*\right)$$

Where,

$$f^{-1}(t) = \begin{cases} t^3 & if\ t > \frac{6}{29} \\ 3\left(\frac{6}{29}\right)^2\left(t - \frac{4}{29}\right) & otherwise \end{cases}$$

C. Lab color space

The overall concept starting from conversion of original image to L*a*b* color space and then object segmentation is represented through block diagram.

Figure 1.Color Image Segmentation for Medical Images using L*a*b* Color Space

D. Color difference

The difference or distance between two colors is a metric of interest in color science. It allows people to quantify a notion that would otherwise be described with adjectives, to the detriment of anyone whose work is color critical. Common definitions make use of the Euclidean distance in a device independent color space.

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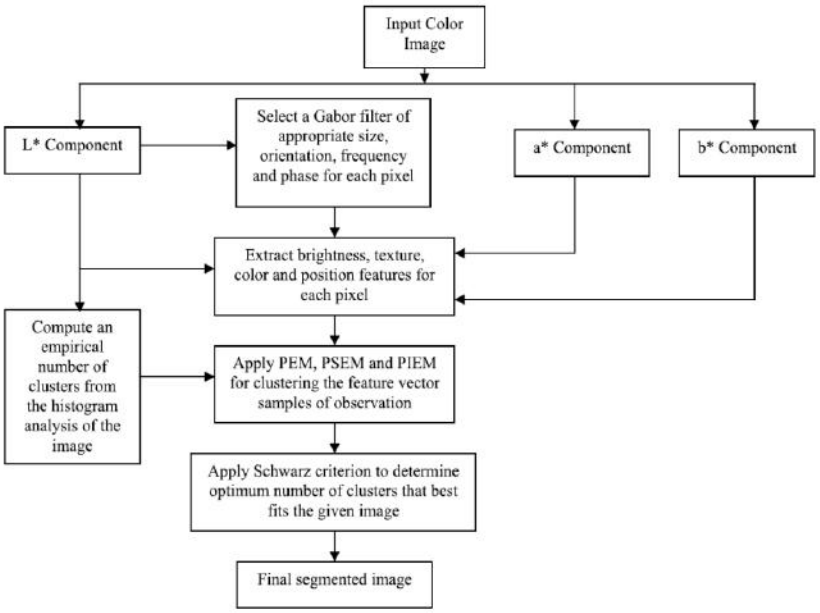

a. Delta E

The International Commission on Illumination (CIE) calls their distance metric ΔE^*ab (also called ΔE^*, dE*, dE, or —Delta El) where delta is a Greek letter often used to denote difference, and **E** stands for *Empfindung*; German for "sensation". Use of this term can be traced back to the influential Hermann von Helmholtz and Ewald Hering. In theory, a ΔE of less than 1.0 is supposed to be indistinguishable unless the samples are adjacent to one another. However, perceptual non-uniformities in the underlying CIELAB color space prevent this and have led to the CIE's refining their definition over the years. These non-uniformities are important because the human eye is more sensitive to certain colors than others. A good metric should take this into account in order for the notion of a "just noticeable difference" to have meaning. Otherwise, a certain ΔE that may be insignificant between two colors that the eye is insensitive to may be conspicuous in another part of the spectrum [6].Unit of measure that calculates and quantifies the difference between two colors -- one a reference color, the other a sample color that attempts to match it -- based on L*a*b* coordinates. The "E" in "Delta E" comes from the German word "Empfindung," meaning "feeling, sensation Delta" comes from the Greek language, and is used in mathematics (as the symbol Δ) to signify an incremental change in a variable, i.e., a difference. So, "Delta E" comes to mean "a difference in sensation." A Delta E of 1 or less between two colors that are not touching one another is barely perceptible by the average human observer; a Delta E between 3 and 6 is typically considered an acceptable match in commercial reproduction on printing presses. (Note: Human vision is more sensitive to color differences if two colors actually touch each other.) The higher the Delta E, the greater the difference between the two samples being compared. There are several methods by which to calculate Delta E values, the most common of which are Delta E 1976, Delta E 1994, Delta E CMC, and Delta E 2000. Delta E 2000 is considered to be the most accurate formulation to use for small delta E calculations (<5). Daylight human vision (a.k.a., photopic vision) is most sensitive to the green region of the color spectrum around 550nm, and least sensitive to colors near the extremes of the visible spectrum (deep blue purples at one end and deep reds at the other). For that reason, color differences in the latter regions are harder for the average human observer to detect and quantify, making Delta E measurements for those colors possibly less accurate.

b. Tolerance

Tolerancing concerns the question "What is a set of colors that are imperceptibly/acceptably close to a given reference?" If the distance measure is perceptually uniform, then the answer is simply "the set of points whose distance to the reference is less than the just-noticeable-difference (JND) threshold." This requires a perceptually uniform metric in order for the threshold to be constant throughout the gamut (range of colors). Otherwise, the threshold will be a function of the reference color—useless as an objective, practical guide. In the CIE 1931 color space, for example, the tolerance contours are defined by the MacAdam ellipse,

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which holds L* (lightness) fixed. As can be observed on the diagram on the right, the ellipses denoting the tolerance contours vary in size. It is partly due to this non-uniformity that lead to the creation of CIELUV and CIELAB. More generally, if the lightness is allowed to vary, then we find the tolerance set to be ellipsoidal. Increasing the weighting factor in the aforementioned distance expressions has the effect of increasing the size of the ellipsoid along the respective axis [7].Turgay Celik and Tardi Tjahjadi [7] presented an effective unsupervised color image segmentation algorithm which uses multi scale edge information and spatial color content. The segmentation of homogeneous regions is obtained using region growing followed by region merging in the CIEL*a*b* color space.

c. Delta difference and tolerance

The difference between two color samples is often expressed as Delta E, also called DE, or ΔE. 'Δ' is the Greek letter for 'D'. This can be used in quality control to show whether a printed sample, such as a color swatch or proof, is in tolerance with a reference sample or industry standard. The difference between the L*, a* and b* values between the reference and print will be shown as Delta E (ΔE). The resulting Delta E number will show how far apart visually the two samples are in the color 'sphere'.

Customers may specify that their contract proofs must have tolerances within ΔE 2.0 for example. Different tolerances may be specified for greys and primary colors. A value of less than 2 is common for greys and less than 5 for primary CMYK and overprints. This is somewhat contentious however. Proofing RIPs sometimes have verification software to check a proof against a standard scale, such as an Ugra/ Fogra Media Wedge, using a spectrophotometer. Various software applications are available to check color swatches and spot colors, proofs, and printed sheets. Delta E displays the difference as a single value for color and lightness. ΔE values of 4 and over will normally be visible to the average person, while those of 2 and over may be visible to an experienced observer. Note that there are several subtly different variations of Delta E: CIE 1976, 1994, 2000, cmc delta e [8].

III. METHODOLOGY

User draws region and this finds pixels in the image with a similar color, using Delta E. As well as the RGB image is converted to LAB color space and then the user draws some freehand-drawn irregularly shaped region to identify a color. The Delta E (the color difference in LAB color space) is then calculated for every pixel in the image between that pixel's color and the average LAB color of the drawn region. The user can then specify a number that says how close to that color would they like to be. The software will then find all pixels within that specified Delta E of the color of the drawn region.

IV. COLOR-BASED SEGMENTATION USING PROPOSED CLUSTERING TECHNIQUE

The proposed approach performs clustering of color space. A particle consists of K cluster centroids representing L*a*b* color triplets. The basic aim is to segment colors in an automated fashion using the L*a*b* color space and K-means clustering. The entire process can be summarized in following steps

Step 1: Read the image. Read the image from mother source which is in .JPEG format, which is a fused image.

Step 2: For color separation of an image apply the De-correlation stretching.

Step 3: Convert Image from RGB Color Space to L*a*b* Color Space. How many colors do we see in the image if we ignore variations in brightness? There are three colors: white, blue, and pink. We can easily visually distinguish these colors from one another. The L*a*b* color space (also known as CIELAB or CIE L*a*b*) enables us to quantify these visual differences. The L*a*b* color space is derived from the CIE XYZ tristimulus values. The L*a*b* space consists of a luminosity layer 'L*', chromaticity-layer 'a*' indicating where color falls along the red-green axis, and chromaticity-layer 'b*' indicating where the color falls along the blue-yellow axis. All of the color information is in the 'a*' and 'b*' layers. We can measure the difference between two colors using the Euclidean distance metric. Convert the image to L*a*b*color space.

Step 4: Classify the Colors in 'a*b*' Space Using K-Means Clustering. Clustering is a way to separate groups of objects. K-means clustering treats each object as having a location in space. It finds partitions such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible. K-means clustering requires that you specify the number of clusters to be partitioned and a distance metric to quantify how close two objects are to each other. Since the color information exists in the 'a*b*' space, your objects are pixels with 'a*' and 'b*' values. Use K-means to cluster the objects into three clusters using the Euclidean distance metric.

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Step 5: Label Every Pixel in the Image using the results from K-MEANS.

For every object in our input, K-means returns an index corresponding to a cluster. Label every pixel in the image with its cluster index.

Step 6: Create Images that Segment the Image by Color.

Using pixel labels, we have to separate objects in image by Color.

Step 7: Segment the Nuclei into a Separate Image.

A. Proposed clustering algorithm

Propose clustering algorithm is under the category of Squared Error-Based Clustering (Vector Quantization) and it is also under the category of crisp clustering or hard clustering. Proposed algorithm is very simple and can be easily implemented in solving many practical problems. Proposed algorithm is ideally suitable for biomedical image segmentation since the number of clusters (k) is usually known for images of particular regions of human anatomy. Steps of the proposed clustering algorithm are given below:

1) Choose k cluster centers to coincide with k randomly chosen patterns inside the hyper volume containing the pattern set (C).

2) Assign each pattern to the closest cluster center. i.e. (C_i , i=1,2,...C)

3) Recomputed the cluster centers using the current cluster memberships. (U):

$$u_{ij} = \begin{cases} 1, if \left\| x_j - c_i \right\|^2 \le \left\| x_j - c_k \right\|^2, foreachk \ne i \\ 0, otherwise \end{cases}$$

4)

5) If convergence criterion is not met, go to step 2 with new cluster centers by the following equation, i.e. minimal decrease in squared error:

$$c_i = \frac{i}{G_i} \sum_{k, X_k \in G_i} X_k$$

Where, $|G_i|$ is the size of G_i or $|G_i| = \sum_{j=1}^{n} u_{ij}$

V. RESULTS AND EVALUATION

After the conversion of image into L*a*b* color space, segmentation algorithm is applied.

Figure 5 shows the results of Matlab standard peppers image for two different Region of interest (ROI) (a) first ROI having Delta E <= 30.9 or >30.9 (b) second ROI having Delta E <= 54.3 or > 54.3. And also represents the complete steps to obtain segmentation with selection of object of interest (Region of Interest (ROI)), L*a*b* representation, their histograms and segmented results with matching colors or not matching colors. Figure 8 shows the results of Human Heart image with (a) Original image (b),(c) and (d) Heart image segmented objects with proposed COLOR CLUSTERING Technique (e) color classification scatter plot representation of the segmented pixels in L*a*b* color space. Scatter plot represents clusters of color pixels in the segmented image. Here various heart vessels and heart chambers are segmented from heart image.

Fig.2. a. Original Image b.Region Drew Image

Fig.3. Delta E between images within masked region

https://dx.doi.org/10.22161/ijaems.5.5.8 *ISSN: 2454-1311*

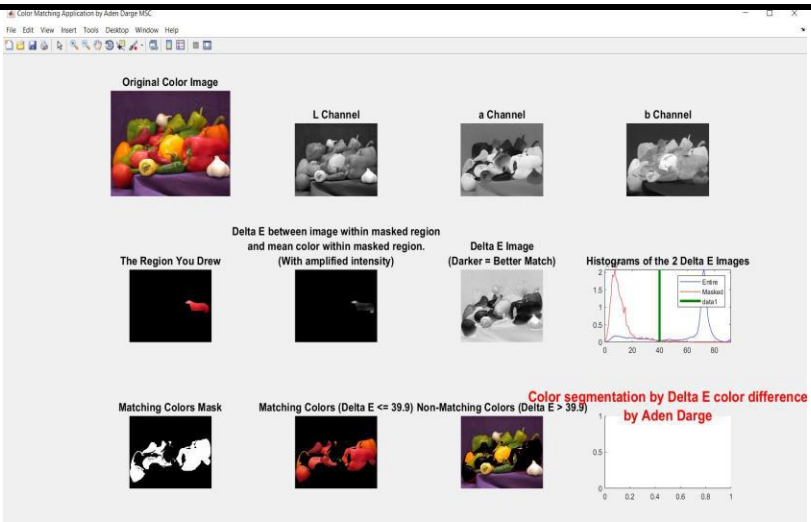

Fig.4: Matching color Mask

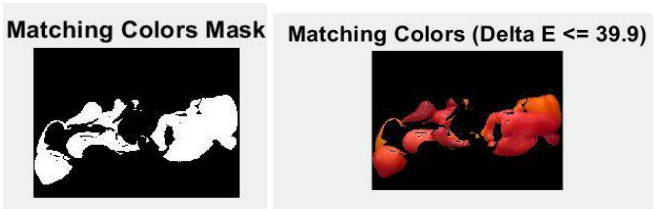

Fig.5. Results of Matlab standard peppers image for two different region of interest (ROI) (a) first ROI having Delta E<=39.9 or >39.9

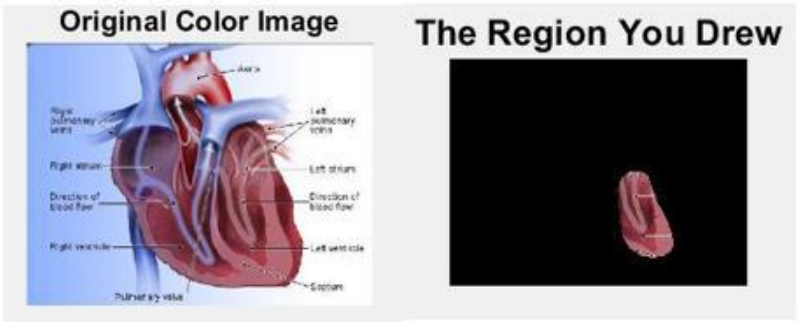

Fig.6. a. Original Image b.Region Drew Image

Fig.7. Delta E between images within masked region

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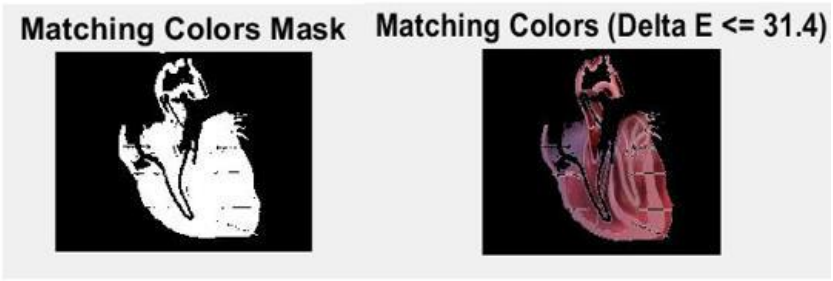

Fig.8. Matching color Mask

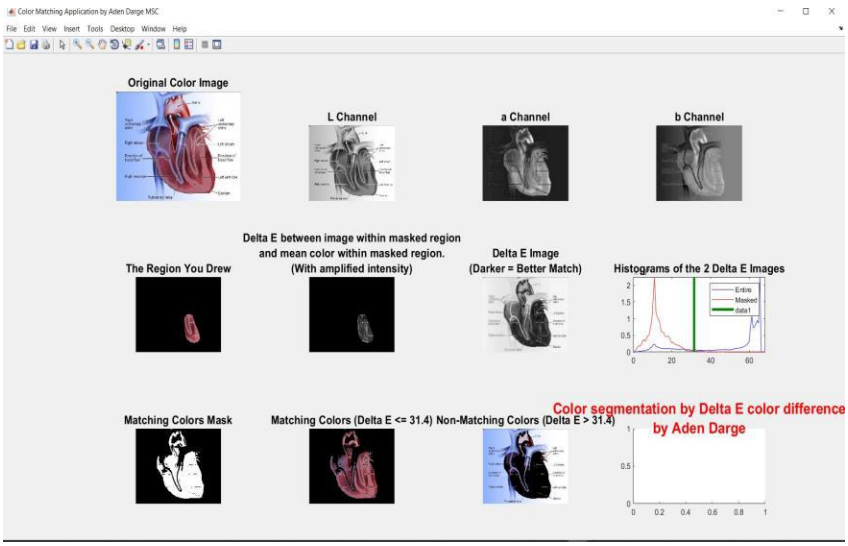

*Fig.9. Results of Human Heart image (a) Original image (b)(c)(d) heart image segemnted objects with proposed COLOR CLUSTERING technique (e) color classification scatter plot representation of the segmented pixels in L*a*b color space having Delta E<=31.4 or >31.4.*

VI. CONCLUSION

The approach of employing color clustering image segmentation using L*a*b* color space for any standard images is proposed. Color clustering image segmentation algorithm, segments the important object information from images. The effectiveness of the proposed method is tested by conducting two sets of experiments out of which one is meant for medical images segmentation and one for standard images from Mat Lab software. This L* a* b* is also providing better segmentation result for all color images.

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Solar Energy Utilization for Bagasse drying through Hollow Shape Slat Chain Conveyor

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Abstract**—** *The utilization of bagasse as a fuel in sugar cane industry is well known. The moisture content of fresh bagassse is relatively high which lowers the total heat available from bagasse and effects its combustion efficiency. Therefore bagassse drying has become a necessity in order to improve its combustion efficiency. In the present work, the use of parabolic trough solar collector to generate the heat steam from working fluid is studied. A working fluid is heated up to 398°C as it circulate through the receiver pipes and return to the heat exchanger. Hence, the working fluid circulate through the pipes so it transfers heat to low temperature, low pressure steam, received from Multi Effect Evaporator outlet to generate high temperature steam. The high temperature steam from heat exchanger move towards hollow shape slat chain conveyor to drying bagasse. Heat requirement, Number of transfer unit and heat capacity ratio were calculated as 238662 KWh, 72372W and 0.5 respectively. Thickness of upper surface of hollow shaped slat chain conveyor made from steel was found as 1cm, through which the moisture reduction ratio as 0.20 was found in the 8min drying of bagasse.*

Keywords**— bagasse, sugar cane industry, gravimetric method.**

I. INTRODUCTION

The study area located in the eastern plain zone of Uttar Pradesh, India. Barabanki district of Uttar Pradesh has 3.6 per cent cultivated area for sugarcane production. The total area of sugarcane production is 9.6 thousand hectares with an average productivity as 53693 kg/hectare as per Agriculture contingency plan for Barabanki district of Uttar Pradesh. The Dhampur sugar mill Rauzagaon located in this district has good connectivity with national highway (NH-28) at 27°19' and 26°30' north latitude and 80°05' and 81°51' east longitude. This mill has crushing capacity of 45,500 metric tonnes per day capacity to produce 1700 metric tonnes refined sugar/day. This mill is the first in India to manufacture surplus refined sugar.

Bagasse is the residual fibre that remains after the crushing of sugarcane. Bagasse represent 12 per cent moisture of the total sugarcane mass. As observed, the average moisture content in the bagassse is between 50.18 per cent to 52.30 per cent with this percentage of moisture content the efficiency of boiler is about 70.86 per cent. Since the objective of this paper is to dry the wet bagasse by using newly designed hollow shaped slat chain conveyor to improve the efficiency of boiler, so that the cost of sugar production get reduced.

II. MATERIAL AND METHOD

The moisture content just after crushing of sugarcane in the bagasse has calculated by gravimetric method on dry weight basis. For drying its moisture. Parabolic solar collector heats a working fluid upto the temperature of 398°C, which circulates through the receiver pipe and returns to heat exchanger. The high temperature steam from heat exchanger moves toward hollow shape slat chain conveyor to dry the wet bagasse. Heat conduction and convection takes place between steam and conveyor bed. Hence, top surface of conveyor bed gets high temperature. As soon as bagasse moves on conveyor surface it receive heat and looses moisture upto the inlet of boiler furnace.

Heat Capacities of working fluid and steam were calculated by multiplying mass of working fluid to the specific heat of working fluid. Similarly mass of steam to the specific heat of steam, respectively. The circulating heat capacity ratio, obtained by dividing the heat capacity ratio of steam to the working fluid. The number of transfer unit (NTU) is obtained by dividing the product of heat transfer coefficient and surface are of conveyor to the heat capacity ratio of steam. With the help of NTU curves effectiveness of heat exchanger was found which is multiplied by maximum heat transfer to get the effectiveness of the heat exchanger used in the study. From the graph of drying Kinetics, the moisture ratio reduction is calculated for a particular time.

III. RESULT AND DISCUSSION

The crushing capacity of the mill is 45500 MT/ day and production of bagasse at 12% was found as 5460 MT/day. Wet sampled weight of bagasse taken, found as

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253.17 gm and after drying it has found as 172.68 gm. For this sample, moisture content obtained as 47.12% in the bagasse. M. Manickavasagam, et. al. (2018) also used gravimetric method for moisture content determination. Time consumption was normally 6-8 hour. They found 46 to 52 per cent moisture content in various samples collected and estimated in their experiments. These values are very much in corroboration to the results of moisture content calculated under study. The heat requirement for bagasse drying is calculated by the formula,

$Q = m \times c \times \delta t$

where, m = mass of bagasse in Kg.

c = Specific heat in KJ/Kg ^oC

δt = Change in temperature of working fluid and outlet temperature of MEE.

Hence, Q = 45500 x 1000 x 0.548 x (400^oC -57^oC)

455 x 1065 x 0.548 x 343^oC

= 2386662 KWh.

Heat capacity of hot fluid (C_h) and steam (C_c) respectively calculated as

$Ch = m_{fh} \times C_{ph} = 100 \times 4.277 = 427.70$ = Abbrebiated as Cmax

$Cc = m_{fc} \times C_{pc} = 100 \times 2.110 = 211.00$ = Abbrebiated as Cmin

Where,

m_{fh} - Mass flow rate of working fluid of PTC.

C_{ph} – Specific heat of working fluid of PTC.

m_{fc} - Mass flow rate of steam received from outlet of MEE.

C_{pc} – Specific heat of steam received from outlet of MEE.

Heat capacity ratio = 211 / 427.70 = 0.5 ,and

NTU = 211(400^oC – 57^oC) = 72373 W, and

Effectiveness of Counter flow heat exchanger, obtained from effectiveness – NTU Curves as heat exchanger duty = effectiveness of heat exchanger x maximum heat transfer

= 1 x 72373

= 72373 kW

Now, average heat transfer coefficient (H), calculated by –

$H = 0.036 (k/L) (Re)^{4/5}(Pr)^{1/3}$

$= 0.036 (6.00616 \times 10\text{^-}3) (2.128 \times 10\text{^}8)^{4/5} (9.9768 \times 10\text{^-}3)^{1/3}$

$= 213.936$ W/m^2K

and from equation , $Q = H \times A \times (T_{c2} - T_{sfl})$

$72373 = 213.936 \times 60 (400 - T_{sfl})$

$T_{sfl} = 394.36$ ^oC

Where,

T_{c2} = Temperature of steam.

T_{sfl} = Temperature at the lower surface of bed.

Temperature of upper surface depends upon the thermal conductivity of material, used to made for conveyor bed. Steel has taken for conveyor bed which gives the temperature of top surface of conveyor as 394.11^oC. From the graph of drying Kinetics of sugarcane bagasse at different temperature, in 8min duration the moisture reduction ratio found as 0.20. The temperature of conveyor bed controlled by varying mass flow rate of steam flow and by mounting pressure releasing valves at the inlet of conveyor.

IV. CONCLUSION

The first conclusion is that a significant part of the demand can be covered with a small field. The parabolic trough collectors have the area as 174715 Sqm for collecting solar energy. The hot pressurized water, as working fluid taken in the study. Results of the study support the recent motivation. The aim of the introduction of dryer was to reduce moisture content in wet bagasse in order to improve boiler efficiency and reduce device costs. The obtained results show clearly that these aim were succeeded. The boiler efficiency was improved from 69 per cent to 81 per cent.

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Evaluation of Haematological Parameters among Cigarette Smokers who Drink local Gin in Ogba/ Egbema/ Ndoni Local Government area of Rivers State

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***Abstract*—** *Cigarette and cannabis smoking and drinking local gin are closely associated with people of different age groups. This study focused on the haematological evaluation of the effect of local gin consumption alongside cigarette and cannabis smoking on haematological parameters in residents of Ogba/Egbema/Ndoni Local Government of Rivers State. One hundred and eighty subjects were recruited for this study and the age bracket was between 22 – 65 years. Thirty of the subjects served as the control, thirty other subjects were drinkers of local gin alone, thirty other subjects were smokers of the mainly donchester brand of cigarette and cannabis popularly called "igboo" and the remaining ninety subjects were drinkers of local gin who also smokes cigarette and cannabis. The subjects 4ml of blood was withdrawn into EDTA specimen container for full blood count assay after obtaining consent from the subjects. BC-2800 Auto Haematology Analyzer was used for the assay for FBC while Westergren method was used for erythrocyte Sedimentation Rate (ESR). Statistical package for the Social Sciences (SPSS) Version 21 was used for analysis for mean, standard deviation, ANOVA and correlation. The results showed that mean cell volume (MCV), Packed cell volume (PCV), White blood cell (WBC), Red blood cell (RBC), and neutrophil were significantly higher in local gin drinkers who also smoke cigarette $P<0.05$ compared with control. Conversely, the erythrocyte sedimentation rate, platelet, heaemoglobin, mean cell haemoglobin, mean cell haemoglobin concentration, monocytes, lymphocytes were not significant when compared with the control. The results showed that neutrophil increased significantly with P-value of 0.16 and F=1.89, Mean cell volume increased significantly with P-value 0.23, Red blood cell increased significantly with P-value 0.34, White blood cell increased significantly with P-value 0.20 and PCV increased significantly with a P-value of 0.55. The correlation of the parameters that showed increased significance among the subjects showed MCV =0.54 among local gin drinkers who smoke and local gin drinkers alone, but the RBC = -0.67 among cigarette smokers who drink local gin and only smokers alone, correlation among local gin consumers only and cigarette smokers alone showed MCV=0.131, WBC= 1.45 and PCV = 0.45. Therefore, this study suggests that a significant increase in neutrophil, RBC, MCV, WBC and PCV may be due to frequent consumption of local gin and frequent smoking of cannabis and cigarette. Drinkers of local gin and smokers of cigarette and cannabis in Ogba/Egbema/Ndoni Local Government Area should be informed of the implications of this social habit in their haematological parameters.*

***Keywords*— Haematological, Local gin, Cigarette, Smokers and drinkers.**

I. INTRODUCTION

Local gin and cigarette smoking are seen as a social habit of so many alcoholics that we see in water side environments and environments that some form of street hideouts are known for especially in environment or areas that are prone to crisis and cult activities. Local gin is called different names for different people and in a different area, such names are ogogoro, kai-kai, root and hard man. Cigarette smokers of different brands are often times associated with alcohol consumption. In the local areas where this research was conducted are mainly smokers who are local gin

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drinkers especially in small corners of the street called "joint." They can always be seen early hours of the morning in those areas and most of them are low-income earners to middle-income earners.

Haematological parameters are of immense importance as they provide diverse and vital information about a population under investigation (Ernst *et.al;* 1990). Several factors determine the value of any particular haematological parameters under assessment (Ernst *et.al*; 1990); the importance of various population and gender-specific reference values cannot therefore be over emphasized (Dirren *et.al*; 1991).

Most of the studies done in the area of cigarette smoking and alcohol consumption has always seemed to be subjective because there are different brands of cigarette as well as different brands of alcoholic beverages with different concentration of alcohol and by so all are generalized as smoking cigarette and drinking alcohol.

Smoking and drinking has shown to raise mean cell volume but does not affect haemoglobin, Red blood cell count and leucocytes counts (Carole, 2010). Heavy smoking and heavy drinking have also increased haemoglobin concentration of the blood. Alcohol consumption decreases white blood cell count but cigarette smoking increases the total peripheral blood leucocyte.

II. OBJECTIVES OF THE STUDY

1. To determine the haematological parameters among local gin drinkers.
2. To determine haematological parameters among cigarette smokers.
3. To evaluate the relationship between local gin consumption and smoking on haematological parameters.

Cigarette smoking and alcohol consumption have been found to be a major depressive disorder in leucocyte count for men (Surtees, 2003).

The most common brand of cigarette younger generations smoke is Donchester and cannabis but the older generations smoke mainly Benson and Hedges. Rivers State Government banned the sale and consumption of Local gin in the State due to the death of about 66 persons in Woji town and Trans-Amadi (DailyPost, 2015). Cigarette packs are clearly written with an inscription that the federal Ministry of health warns that smokers are liable to die young and cannabis smokers see cannabis in a different light from other brands of cigarettes. That informs the reason for this research work.

According to 2006 census, Ogba/Egbema/Ndoni Local Government Area of Rivers State is said to have a population of about 218,350 persons. Ogba/Egbema/Ndoni Local Government Area is located within the Orashi region of Rivers State where oil is the most abundant mineral resources. It is a local Government that has people of four different languages such as Egbema speaking, Egi speaking, Omoku speaking, and Ndoni spoken languages. The area is known for its oil and gas-rich environment but a lot of the youths and elderly are of low-income earners and middle-income earners despite the fact that it is acclaimed that three major oil multinational companies residing in the area will make the people of the area rich.

III. MATERIALS AND METHODS

3.1 Study sites

This study was carried out in Ogba/Egbema/Ndoni Local Government Area of Rivers State, Nigeria with the approval of Ogba/Egbema/Ndoni Community Healthcare Ethics Committee.

3.2 Sample Size.

For calculating sample size, the formula proposed by Cochran, (1977) was adopted and a total of 180 adult volunteers between the ages of 22-65 years were recruited.

3.3 Sample Collection

Four milliliters of the venous blood sample was collected from the median antecubital vein of the subjects left upper limb in the morning hours between 7 a.m to 8 a.m and it was in the fasting state for all the subjects. The 4ml of blood was taken with the aid of syringe and put in Ethylenediaminetetraacetic acid (EDTA) bottle. The time between collection and assay was between 1-2hours. Auto Haematology Analyzer BC-2800 was used to determine the complete blood count, and Erythrocyte Sedimentation Rate (ESR) was performed using the Westergren Method.

3.4 Statistical Method

Statistical analysis was done using software; Statistics Package for Social Sciences (SPSS) version 20. Analysis of variance (ANOVA) was used to compare parameters among groups, descriptive statistics were also used (Mean and Standard deviation) to compare between groups. An alpha value of < 0.05 denoted a statistically significant difference.

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IV. RESULTS

Table.4.1: Haematological parameters of smokers and control.

Parameters	Control N=30	Smokers N=30	F Value	P-value
Neutrophils (%)	31.9 ± 15.2	34.3 ± 8.2	1.89	0.16
Haemoglobin (g/dl)	149 ± 2.5	16.1 ± 2.45	4.9	0.01
PCV (%)	53.8 ± 9.0	60.5 ± 15.4	0.604	0.55
RBC (10^{28}/L)	6.08 ± 1.4	5.4 ± 2.45	1.094	0.34
WBC (10^9/L)	4.3 ± 1.6	7.2 ± 2.5	1.65	0.20
ESR (mm/hr)	21.1 ± 9.7	35.3 ± 27.3	4.75	0.01
MCV (fl)	85.0 ± 7.9	87.9 ± 6.9	1.52	0.23
MCH (pg)	23.4 ± 2.34	26.0 ± 2.97	4.85	0.01
Platelet count	231.7 ± 92.8	135 ± 92.8	6.25	0.004
(10^9/L)	13.9 ± 8.7	15.3 ± 3.8	3.1	0.05
Monocytes (%)	56.2 ± 13.4	50.3 ± 6.9	2.4	0.10
Lymphocytes (%)	23.4 ± 2.3	34.3 ± 2.1	4.8	0.00
MCHC (g/L)				

Results are mean ± SD. Key words: Packed cell volume (PCV), Mean cell volume (MCV), Erythrocyte sedimentation rate (ESR), Mean cell Haemoglobin (MCH), Mean cell haemoglobin concentration (MCHC), Red blood cell (RBC), White blood cell (WBC)

Table.4.2: Haematological parameters of drinkers and control

Parameters	Control	Drinkers	F (P) Value	P-value
Neutrophils (%)	31.9 ± 15.2	32.2 ± 8.7	1.89	0.16
Haemoglobin (g/dl)	149 ± 2.5	16.5 ± 2.5	4.9	0.01
PCV (%)	53.8 ± 9.0	55.6 ± 4.12	0.604	0.55
RBC (10^{28}/L)	6.08 ± 1.4	6.57 ± 1.3	1.094	0.34
WBC (10^9/L)	4.3 ± 1.6	7.23 ± 2.5	1.65	0.20
ESR (mm/hr)	21.1 ± 9.7	15.6 ± 8.8	4.75	0.01
MCV (fl)	85.0 ± 7.9	87.7 ± 4.68	1.52	0.23
MCH (pg)	23.4 ± 2.34	25.5 ± 1.6	4.85	0.01
Platelet count (10^9/L)	231.7 ± 92.8	199 ± 60.2	6.25	0.004
Monocytes (%)	13.9 ± 8.7	17.6 ± 5.3	3.1	0.05
Lymphocytes (%)	56.2 ± 13.4	48.2 ± 8.5	2.4	0.10
MCHC (g/L)	23.4 ± 2.3	30.1 ± 1.98	4.8	0.00

Results are mean ± SD. Key words: Packed cell volume (PCV), Mean cell volume (MCV), Erythrocyte sedimentation rate (ESR), Mean cell Haemoglobin (MCH), Mean cell haemoglobin concentration (MCHC), Red blood cell (RBC), White blood cell (WBC).

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Table.4.3: Haematological parameters of ogogoro drinkers who smoke cigarettes and control.

Parameters	Control N=30	Drinkers & Smokers N=90	F (P) Value	P-value
Neutrophils (%)	31.9 ± 15.2	36.6 ± 6.98	1.89	0.16
Haemoglobin (g/dl)	149 ± 2.5	13.4 ± 3.69	4.9	0.01
PCV (%)	53.8 ± 9.0	51.1 ± 14.9	0.604	0.55
RBC (10^{28}/L)	6.08 ± 1.4	5.86 ± 1.71	1.094	0.34
WBC (10^9/L)	4.3 ± 1.6	5.17 ± 2.01	1.65	0.20
ESR (mm/hr)	21.1 ± 9.7	33.3 ± 25.6	4.75	0.01
MCV (fl)	85.0 ± 7.9	89.4 ± 7.86	1.52	0.23
MCH (pg)	23.4 ± 2.34	25.8 ± 2.33	4.85	0.01
Platelet count (10^9/L)	231.7 ± 92.8	141± 94.9	6.25	0.004
Monocytes (%)	13.9 ± 8.7	12.7 ± 4.58	3.1	0.05
Lymphocytes (%)	56.2 ± 13.4	51.4 ± 7.89	2.4	0.10
MCHC (g/L)	23.4 ± 2.3	29.1 ± 1.52	4.8	0.00

Results are mean ± SD. Key words: Packed cell volume (PCV), Mean cell volume (MCV), Erythrocyte sedimentation rate (ESR), Mean cell Haemoglobin (MCH), Mean cell haemoglobin concentration (MCHC), Red blood cell (RBC), White blood cell (WBC).

Table.4.4: Correlation of Neutrophil, Packed cell volume, Red blood cell, White blood cell, and Mean cell volume.

Parameters	Neutrophil	PCV	RBC	WBC	MCV
r	-2.6	-0.49	-1.68	-0.543	0.54
Significance	0.16	0.55	0.342	0.202	0.229

Table.4.5: Correlation of Neutrophil, packed cell volume, red blood cell, white blood cell, and mean cell volume among cigarette smokers who drink ogogoro and only cigarette smokers alone.

Parameters	Neutrophil	MCV	RBC	PCV	WBC
r	0.6	1.53	-0.67	21.86	4.43
significance	0.16	0.55	0.342	0.202	0.229

Table.4.6: Correlation of Neutrophil, packed cell volume, red blood cell, white blood cell, and mean cell volume.

Parameters	Neutrophil	MCV	RBC	WBC	PCV
r	-4.67	0.131	-1.031	1.45	0.43
Significance	0.16	0.55	0.342	0.229	0.202

V. DISCUSSION

Several studies have shown that alcohol consumption and cigarette smoking has an impact on the blood cells (Jaana *et.al.*, 2004 ; Paolo *et.al*., 1996) and also has effect also haematological parameters (Erhabor *et.al*., 2013). Cancer, cirrhosis of the liver, visual problems and many form of mental health is not just enough to show that alcohol and cigarette have effect on brain, liver, eye, heart, and blood vessels (Ross *et.al*., 2016). Therefore, in this study we decided to show the effect local gin that is locally brewed in Ogba/Egbema/Ndoni Local Government Area and other parts of West Africa especially Rivers State generally and cannabis smoking that you see young people wrap. To some extent, the results obtained from this research is not subjective like other research conducted on alcohol consumption by undermining brands and alcohol concentration of the different brands that are not brewed even in West Africa.

Chronic alcohol consumption has been suggested as one of the factors that may lead to hypocellularity (decreased production of the erythrocytes, leucocytes and thrombocytes). These lead to anaemia, leucopenia, thrombocytopenia and their relative sequelae (Latvala *et.al*., 2014 and Vatn *et.al*., 2001).

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In this study, among the three main red blood cell indices that help in measuring the average size and haemogobin composition of the red blood cells (MCV, MCH & MCHC); the study established significantly larger values of mean cell volume among drinkers of local gin, smokers of cannabis and cigarette smoking and drinkers of local gin alongside cigarette and cannabis smoking, confirming a research by Asif et al., while MCHC showed no level of significance in the study among smokers, drinkers and smokers and drinkers (P=0) but the level of MCH among smokers, drinkers and smokers and drinkers were lowered. Although Asif et al., 2010 found an increase in MCV and decrease in MCH and MCHC levels of smokers. The finding of this research agrees with the finding made by (Salamzadeh, 2012) to some extent that the amounts of MCH and MCHC in smoker group were significantly lower ($P<0.05$) compared to non-smoker group.

The red blood cell level of smokers, drinkers and smokers who drink local gin increased as compared to the control subjects. This could be due to the level of smoking and consumption of local gin as well. This further confirms studies by (Maja *et.al*., 2017).

In this study, there was an increase in packed cell volume but a decrease in haemoglobin level among the smokers of cannabis, drinkers of local gin and smokers of cannabis who drink local gin. This supports a study by Lakshmi *et.al* 2012 that showed a significant increase in smokers haematocrit but this study contradicts his study that smoking also increases haemoglobin level. In this same study Lakshmi et.al 2012 also agreed that there was significant high red blood cell count in smokers and drinkers as the intensity of smoking and drinking increases. Increased number of red blood cell but decrease level of haemoglobin cannot be explained by the fact that tissue hypoxia caused by carbon monoxide leads to increased secretion of erythropoietin, thus causing erythropoiesis.

This study went further to show that erythrocyte sedimentation rate was significantly not elevated among smokers of cannabis and cigarette, drinkers of local gin and smokers of cannabis who drink local gin as compared to study that show showed a high level of erythrocyte sedimentation rate in chronic alcoholics compared to non-alcoholics (Erhabor, 2011; Wood 1987).

The platelet count showed that cannabis and cigarette smoking, local gin consumption and smoking and consuming local gin has a significant effect as compared to those who don't smoke, drink and smoke and drink alongside. Although similar studies showed that there is a significant difference between the platelet counts of chronic alcoholics and non-alcoholics, that thrombocytopenia was greatly significant among alcoholics compared to non – alcoholics (Teddy *et.al*., 2013).

This study established a significantly larger number of white blood cells among smokers of cannabis and cigarette, drinkers of local gin and those who smoke cannabis and drink local gin alongside in comparison to the control group. The increased white blood cell count observed is similar to earlier studies (Maja, 2017; Inal, 2014; Higuchi, 2016). Although the exact mechanism of how smoking of cannabis and drinking of local gin increases the number and level of white blood cell is not well known

Some authors claim that an increase in the level of white blood cells can be the damage done by nicotine-induced release of catecholamines and steroid hormones from the core of the adrenal gland. It is not known that increase in the level of certain endogenic hormones, such as epinephrine and cortisol, results in an increase in the number of white blood cell (Kapoor, 2015; Deutsch, 2012).

The white blood cell differential that showed a significant increase is the neutrophil. A study also confirms that smoking and drinking increases the level of neutrophil (Oduola *et.al*., 2015). The neutrophil levels of smokers of cannabis, drinkers of local gin and smokers of cannabis who drink local gin respectively increased. But the lymphocyte count and monocyte count showed that local gin consumption, cannabis smoking and drinking local gin and smoking alongside did not have a significant effect as compared to the control subjects.

VI. CONCLUSION

From the present study, we can conclude that cannabis and cigarette smoking increases red blood cells, white blood cells, mean cell volume, neutrophil count and packed cell volume, we also conclude that local gin consumption increases red blood cells, white blood cells, mean cell volume, neutrophil count and packed cell volume and lastly conclude that smokers of cannabis and cigarette who drink local gin has a significant increase in red blood cells, white blood cells, neutrophil count, packed cell volume and mean cell volume. The change in these haematological parameters might be associated with a greater risk for developing cardiac diseases such as atherosclerosis, polycythemia vera, and possible leucocytosis.

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