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Cellular Transport Systems

Drop and Transesterfication

Highlights

Develop Green Environment

Coupling of Texturing/Cooling

Discovering Thoughts, Inventing Future

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Scenario-based Cycle Time Comparison of Cellular Transport Systems with Conventional Warehouse Systems

By Elif Karakaya, Hakan Tozan, Mumtaz Karatas & Michael R. Bartolacci
National Defense University, Turkish Naval Academy

Abstract- In today's business environment of rapidly changing customer demands, varying online order quantities, tight delivery schedules, and high customer service level requirements, it is becoming increasingly difficult for companies to achieve high performance standards using existing warehousing systems. The well-structured traditional warehouse system cannot meet the huge challenge of adapting requirements to today's global market which requires greater flexibility and faster operation capability in managing inventory. Alternative warehouse methodologies should be appropriate for the value added chain concept of companies, have enough flexibility to adapt to market conditions, and be strongly agile to overcome the late or no delivery risk. At this point, the Cellular Transport System (CTS) has been developed as an alternative system by the Fraunhofer Institute for Material Flow and Logistics. In this study, the comparison of CTS with conventional systems by using cycle time calculation is provided.

Keywords: cellular transport system, warehouse system, cycle time, spreadsheet modeling.

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Elif Karakaya [α], Hakan Tozan [σ], Mumtaz Karatas [ρ] & Michael R. Bartolacci [ω]

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Keywords: cellular transport system, warehouse system, cycle time, spreadsheet modeling.

I. Introduction

Warehouse systems play an ever-increasing role in companies including impacting crucial operations points such as the on-time delivery of goods and service quality Automated Storage and Retrieval Systems (AS/RSs) have been widely used in distribution and production environments since their introduction in the 1950s. Between 1994 and 2004, there has been a significant increase in the number of AS/RSs used in distribution environments (Roodbergen and Vis, 2009).

An AS/RS is mostly utilized in distribution centers and production environments in order to store raw materials or (semi-) finished products in racks and to pick products requested by customers from storage to complete an order. An AS/RS is fully automated and can store or retrieve products without the assistance of a worker. Although these systems have several advantages over manual warehouse systems, such as providing accurate and effective handling of product, resulting in savings in both space and labor costs, their high installation and maintenance costs are a definite concern. In its most basic form, an AS/RS consists of storage racks served by cranes running through aisles between two racks where products or raw materials/components are stored and retrieved automatically.

Another novel warehouse system for automated handling is the Autonomous Vehicle Storage and Retrieval System (AVS/RS) which has been implemented at scores of facilities that reside primarily in Europe (Malmborg, 2002). Furthermore, this form of warehouse system has successfully been implemented at a particular French distribution center. The AVS/RS, explained by Ekren and Heragu (2011) in detail, has the capability to transport products not only within the same aisle but also from one tier to another by using lifts. In other words, autonomous vehicles travel horizontally over rails through aisles and vertically by utilizing elevators. In addition, the main advantage of this type of system is that autonomous vehicles are capable of traveling to other aisles in the case of need at those locations. Thus, they do not have to be bound to a specific aisle as typical AS/RS systems. Gagliardi, et al., (2011) detailed a study of an AVS/RS that was carried out in a French distribution center. This study was based on a strict application of a pure random storage assignment policy with the completion of orders according to a "first come, first serve" rule and a dwell-point policy (which means that autonomous vehicles remain in place after the completion of each transaction).

The AVS/RS system is composed of autonomous vehicles, lifts, conveyors, and storage racks. AVS/RSs utilize a rail system in order to operate in orthogonal directions within high-rise, high-density storage area. The storage area is divided into multiple tiers and each tier has a rail system (Ekren and Heragu, 2011).

Author α: Department of Industrial Engineering, Istanbul Medeniyet University, Istanbul, Turkey. e-mail: elif.karakaya@medeniyet.edu.tr
Author σ: Department of Industrial Engineering, Istanbul Medipol University, Istanbul, Turkey. e-mail: htozan@medipol.edu.tr
Author ρ: Department of Industrial Engineering, National Defense University, Turkish Naval Academy, Istanbul, Turkey. e-mail: mkaratas@dho.edu.tr
Author ω: Department of Information Sciences and Technology, Penn State University – Berks. e-mail: mrb24@psu.edu

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II. Theoretical Background of CTS

In recent years, research activities involving the Internet of Things (IoT) has examined decentralized control systems and their use in warehouse systems (Günthner and ten Hompel, 2010). The Cellular Transport System (CTS) is an example of a decentralized warehouse system that represents the application of IoT in the field of logistics. IoT includes the vision of creating a link between everyday objects through efficient information and communication technologies in order to enable new classes of applications and services. For instance; the RFID technology, one of the technological mainstays of IoT has numerous applications in warehouse systems. Hence, it is possible to change conventional centralized material flow systems using such technologies to decentralized material control systems.

According to a comprehensive definition provided by (ten Hompel and Heidenblut, 2011) “Cellular Transport Systems are based on material handling entities. These entities could be autonomous transport vehicles or autonomous conveying modules. The control and the communication between these autonomous entities are executed by Software Agents. Cellular Transport Systems are flexible in their topology, for this reason, they are able to adapt to environmental changes. Finally, this ensures the overall transport systems’ performance due to the interaction between the material handling entities.” The main principle behind the CTS concept is that decisions are made by the self-governing units that depend on gathered information or probabilistic calculations. Generally speaking, centralized control systems are losing their importance for warehouse management in favor of decentralized control systems. Kamagaew, et al., (2011) state that “hierarchical structures are dissolved towards a mesh-like structure with self-containing entities.” In warehouse systems, autonomous units, each called a Multi Shuttle Move (MSM) unit, consist of a variety of functions the provide consistent communication and negotiation ability, high sensor/actuator properties to gather local information to ensure advanced flexibility, collision avoidance, and task assignment.

MSM is an integration of a standard shuttle’s principle and an Automated Guided Vehicle (AGV) principle which has been implemented by scientists at Germany’s Fraunhofer Institute for Material Flow and Logistics in an attempt to create a novel and effective kind of warehouse system. The MSM is not only capable of moving on a rail which is mounted in the storage rack, but is also able to leave the storage area and work as an AGV in other area using open path navigation. Currently, an experimental implementation of CTS was built on a 1000 square meters footprint with a 65 meter long test area in the Dortmund Fraunhofer IML in order to analyze its exact performance (Kirks, et al., 2012). The entire system, including 50 Multi-shuttle Move® units, 5 order picking stations and storage racks with elevators located two sides of storage, was implemented to examine the performance of CTS as compared with other conventional warehouse systems. The experimental implementation is depicted in Figure 1 below.

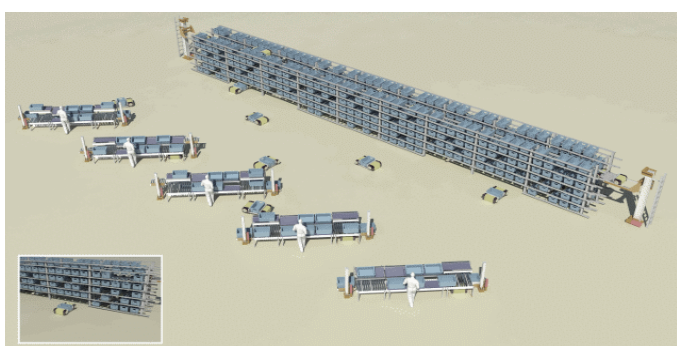

Fig. 1: The experimental area of Cellular Transport System with MSMs © Fraunhofer IML

III. Cycle Time Calculation

a) Automated Storage and Retrieval Systems (AS/RS)

With this type of automated system, one crane is in charge of carrying loads back and forth from storage areas. Also, a conveyor system is used to transport picked items to a packing workstation or onto the actual storage rack. Cycle time, the time it takes for a complete operation, is calculated using what is known as a single command rule. Single command entails that the crane or other transportation vehicle is performing single storage or a single retrieval operation. In order to gain a better understanding of cycle times, detailed explanations about storage and retrieval operations are provided as follows.

In the case of a storage cycle, the machine picks up a load, travels to the storage location, deposits the load, and returns empty to the Input/ Output station. Similarly, in a retrieval cycle, the Storage/ Retrieval machine begins at the Input/ Output station and travels empty to the retrieval location, picks up the load, moves to the Input/ Output station, and deposits the load there.

The view from the top of AS/RS is given in Figure 2. Bozer and White (1984) derived the basic cycle time expressions.

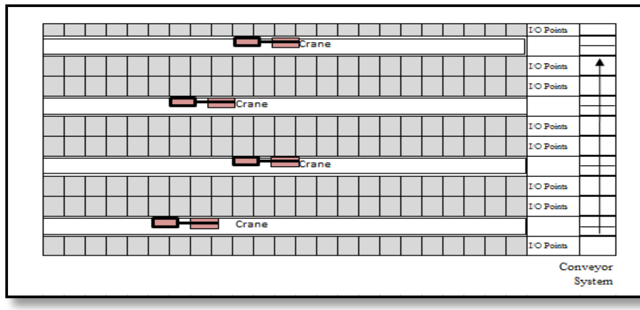

Fig. 2: The components of AS/RS configuration

From this basic system design, the following expression is derived in order to calculate cycle time for a single command transaction. The following equations are generated for a totally randomized storage policy. The notations and equations are given as follows:

$$\overline{T} = \max\left(\frac{L}{v_x}, \frac{H}{v_y}\right) \tag{1}$$

$$b = \frac{1}{T}\min\left(\frac{L}{v_x}, \frac{H}{v_y}\right) \tag{2}$$

$$E(SC) = \overline{T}\left(\frac{1}{3}b^2 + 1\right) \tag{3}$$

where;

v_x : Horizontal velocity of S/R machine

v_y : Vertical velocity of S/R machine

L : Length of the rack

H : Height of the rack

T : Farthest travel time

b : Shape factor

$E(SC)$: Expected single-command round-trip travel time

b) *Autonomous Vehicle Storage and Retrieval Systems (AV/SRS)*

An AVS/RS utilizes a rail system. The storage area is divided into multiple tiers and each tier utilizes a rail system. The rail system allows vehicles to access any location on a tier (level) within the storage area. The configuration of AVS/RS is represented in Figure 3.

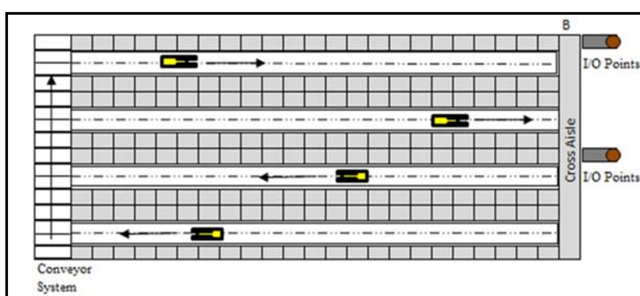

Fig. 3: The components of AVS/RS configuration

Fukunari and Malmborg (2008) derived a mathematical expression to calculate single command cycle time for an AVS/RS. The notations and equation are provided as follows:

$$E(SC) = 2\left\{\left[\frac{T-1}{T}\right](t_h + \frac{1}{\mu_{lift}}) + \frac{t_h}{T} + \delta\right\} \tag{4}$$

where;

T : Number of tiers

t_h : Expected horizontal vehicle travel time

$1/\mu_{lift}$: Expected lift cycle time.

δ : Load transfer time between vehicles and storage positions

c) *Cellular Transport System (CTS)*

In the CTS model, the shuttle moves horizontally with the help of a rail system between storage racks and vertically by means of lifts. The parameters and variables for these components are very crucial for the analytical model. The number of aisles and tiers for the system and the velocities of the lift and shuttles are key parameters of analytical model which are assumed tobe given. The configuration of CTS is illustrated in Figure 4.

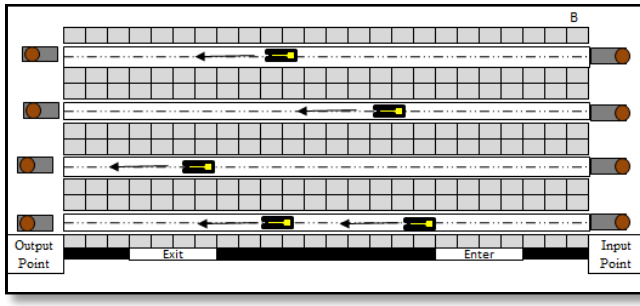

Fig. 4: The components of CTS configuration

With CTS, the single command cycle time calculation depends upon vertical, horizontal and depth movements. The formulation is provided below. The notations and equation are provided as follows:

$$H = T \times y \tag{5}$$

$$L = B \times x \tag{6}$$

$$D = A\left(2W + z\right) \tag{7}$$

$$E\left(SC\right) = \frac{E\left(L\right)}{v_x} + \frac{E\left(H\right)}{v_y} + \frac{E\left(D\right)}{v_x} + \delta \tag{8}$$

Where;

T	:	Number of tiers
B	:	Number of bays
A	:	Number of aisles
W	:	The width per aisle
H	:	Height of the rack
L	:	Length of the rack
D	:	Width of the aisle
x	:	The width of one storage rack
y	:	The height of one storage rack
Z	:	The depth of one storage rack
v_x	:	Horizontal velocity of shuttle
v_y	:	Vertical velocity of lift
$E(L)$	:	Expected vertical vehicle travel time
$E(H)$	:	Expected horizontal vehicle travel time
$E(D)$	:	Expected transverse vehicle travel time
$E(SC)$	:	Expected single-command round-trip travel time
δ	:	Load transfer time between vehicles and storage position

IV. Excel Spreadsheet Application For Comparison

The purpose of the spreadsheet application is to calculate cycle time and it was first introduced by Eldemir et al., (2003) for only an AS/RS. The Excel spreadsheet study is enhanced within the scope of this study with the additions of cycle time calculations for both an AVS/RS and a CTS. The benefit of using a spreadsheet application will be demonstrated through an example calculation for a theoretical system. The dimension of a particular load is supposed to be 5ft×5ft×5ft. The velocity of a crane, vehicle or shuttle differs from one warehouse system to another for both the horizontal and vertical movement. Cycle time is calculated based on a randomized storage policy and uses only single command transactions. For the cycle time computation in the spreadsheet tool, Visual Basic macro codes are embedded in the spreadsheet.

V. Scenarios

a) Essential Scenario

To understand which type warehouse system is more appropriate for a company, an essential scenario is set up with specific decision parameters: 1) Operational parameters which are concerned with warehouse strategies and deal with the number of items to be stored and the product range. 2) Design parameters consist of items related to the exact storage configuration including the number of aisles, bays, and tiers. This study takes into account only operational parameters by creating different scenarios. In the first place, the essential scenario is established by holding both operational and design parameters fixed and the basic specifications of the storage as shown in Figure 5. The number of aisles, tiers and bays are assumed to be 4, 5, and 50, respectively; and the width, length and depth of one storage rack are assumed to be 5ft each. Thus, the entire storage rack dimensions are 20ft×25ft×250ft.

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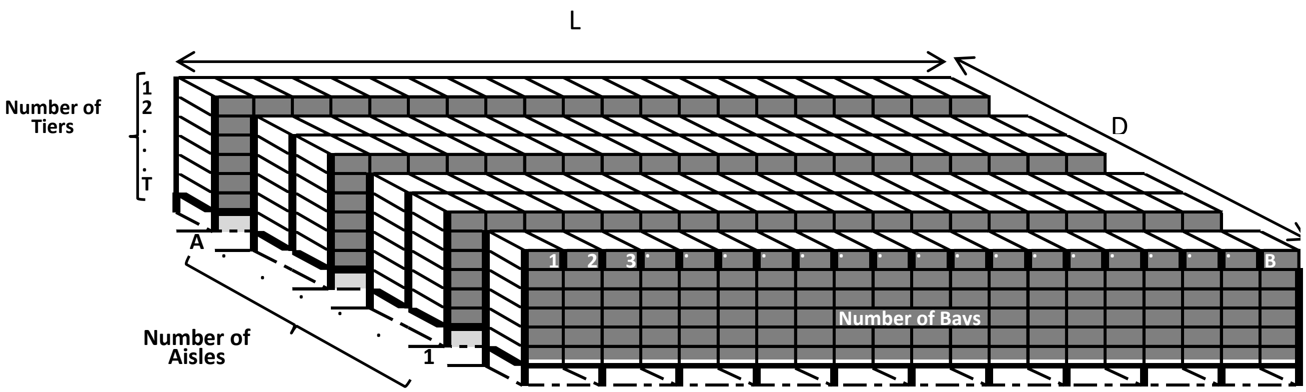


Fig. 5: Storage configuration

It is assumed that 1000 different items are available for this example and each one has its own particular space requirement. The space requirement values can show an alteration according to a uniform distribution, normal distribution, or a constant value defined by the user within the Excel spreadsheet. For the purposes of this study, the space requirement value is uniformly distributed with a minimum value of 1 and a maximum value of 18. The rate of retrieval and storage transactions is the same, and the transaction range is from 4 to 20 per day based on a uniform distribution. All values for the essential scenario are given below in Table 1 and are constant for three alternative warehouse systems.

Table 1: Parameters for the excel spreadsheet application

Prm	Description	Value
S	Number of Different Items	1000
A	Number of aisles	4
T	Number of tiers	5
B	Number of bays (columns) per aisle	50
D	Storage rack depth based on # aisles	20 ft
H	Storage rack height based on # tiers	25 ft
L	Storage rack width based on # bays	250 ft
x	Width of one storage rack	5 ft
z	Depth of one storage rack	5 ft
y	Height of one rack	5 ft
V	Number of vehicles	20
L	Number of lifts	4
λs	Arrival rate of storage transactions	U(4, 20)
λr	Arrival rate of retrieval transactions	U(4, 20)
λsr	Space Requirement Distribution	U(1, 18)
TL/U	Time to load/unload to	3 sec.
TT	Time between the lift and the I/O point	3 sec.

In the spreadsheet application, the total space requirement is based on a random storage principle as estimated by using a Monte Carlo sampling procedure. 10^4 samples are generated for this scenario and each sample is acquired by taking the total number of occupied storage spaces at any given time. After the samples are sorted in increasing order, the sample which has the maximum value is determined as the total space requirement. (Eldemir, 2003). According to the total space requirement, cycle time is calculated for each warehouse systems. The following Table 2 shows that CTS gives the smallest cycle time within the context of essential scenario assumptions if it is compared with other warehouse systems.

Table 2: Parameters for the excel spreadsheet application

Warehouse Systems	Cycle Time (in seconds)
AS/RS	130.615
AVS/RS	175.048
CTS	123.857

b) Change Scenarios for Operational Parameters

To reflect the real case analysis, three alternative warehouse designs are generated and used which vary in terms of company size: small, medium-sized and large company. These three company models are obtained by altering storage configuration and storage/retrieval transaction rates. The number of aisles and the number of tiers are determined during the scenario generation process; however, the number of bays utilized is derived based on the parameters seen in Table 3.

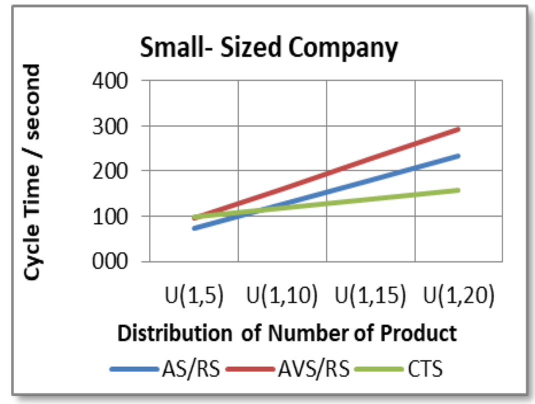
Table 3: Parameters for the excel spreadsheet application

Prm	Description	S	M	L
A	Number of aisles	4	6	8
T	Number of tiers	3	5	7
λs	Arrival rate of storage transactions	U(0, 10)	U(5, 20)	U(10, 30)
λr	Arrival rate of retrieval transactions	U(0, 10)	U(5, 20)	U(10,30)
D	Storage rack depth	20 ft	30 ft	40ft
H	Storage rack height	15ft	25ft	35ft
L	Storage rack width	200 ft	250ft	300ft

The Excel spreadsheet gives opportunities to evaluate the performance of the three warehouse systems using different scenarios. In this paper, two change scenarios are generated: 1) different combinations of space requirements for each item and 2) an increase in the diversity of items. These two scenarios are explained with their properties and results in detail as follows.

c) Scenario 1: Different Combination of Space Requirement

The motivation behind the first scenario is to understand whether or not any difference in cycle time is seen between CTS and other warehouse systems for three facility size options when the space requirement is increased or decreased. In this regard, four different space requirement levels are specified according to uniform distribution: U (1, 5), U (1, 10), U (1, 15) and U (1, 20).



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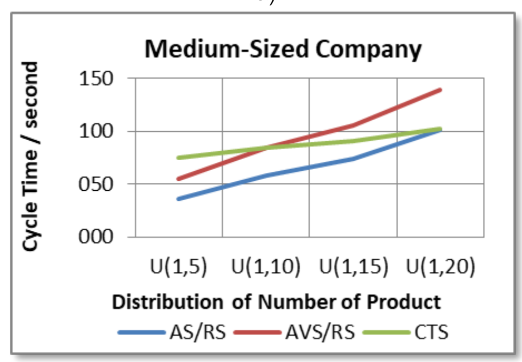

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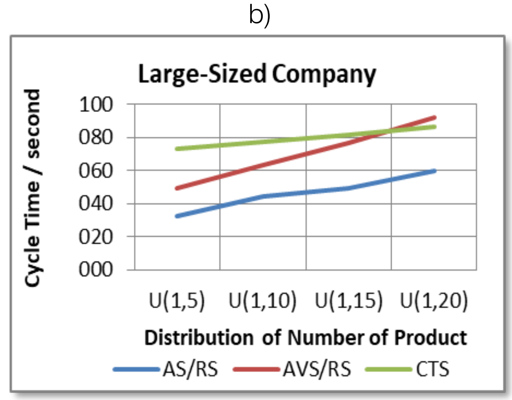


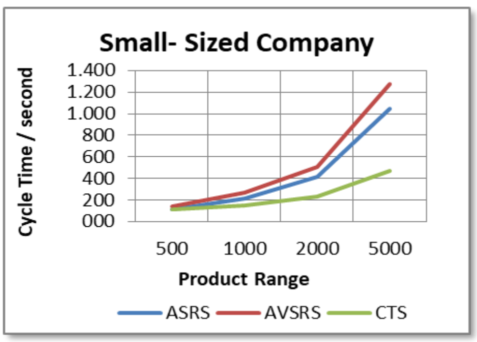
c)

Fig. 6: a), b) and c) Cycle time comparison with regard to company size

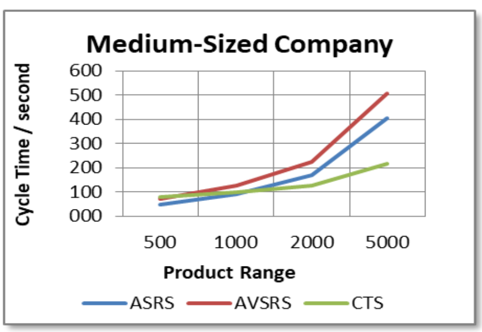
Figure 6 provides the cycle time results of three warehouse systems in response to different product size combinations for the three company types obtained from the Excel spreadsheet. What is interesting in this result is that cycle time is increasing for all-sized companies. However, it is assumed that the cycle time should decrease gradually when the amount of a given product is increased. The reason behind this assumption is the high probability of finding the required item easily because of higher availability rate of items in the warehouse. One of the causes for the cycle time to increase is due to the increased space requirement combined with a random storage policy.

Also, realizing an increasing trend in all graphs of three company sizes proves the greater degree of accuracy on this result. Another important finding is that, although the CTS provided the smallest cycle time for the essential scenario in previous study, it is not an appropriate warehouse solution for medium and large sized companies. This is due to the fact that the number of aisles falls the total cycle time significantly.

d) Scenario 2: Increase the diversity of items



a)



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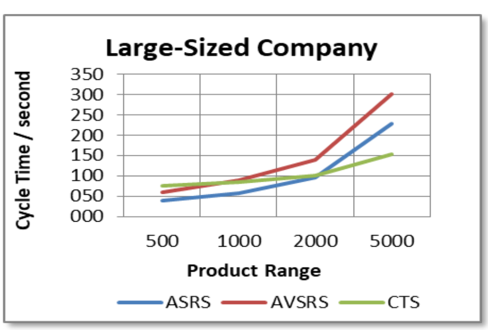

c)

Fig. 7: a), b) and c) Cycle time comparison for different product range

In the second scenario, the variety of products are increased and four different product ranges are generated as 500, 1000, 2000, 5000. The three graphs in Fig.7 show that there has been a sharp rise in the cycle time when the product range is increased from 500 to 5000 incrementally. Therefore, when any large or medium sized company does not have a diversified amount of product, the AS/RS fits well as a warehouse system.

Besides, the horizontal and vertical velocities are different for all kind of warehouse systems. For instance, the crane within the AS/RS storage rack moves 5 feet/second whereas, the shuttle for an AVS/RS moves 4.16 feet/ horizontally. On the other hand, the multi-shuttles in the CTS travel inside the storage rack 6.56 feet per second and outside the storage with the velocity of 3.28 feet/ second. The speed for vertical movement is same for all three warehouse systems with 1 foot/ second. Therefore, the CTS gives the smallest cycle time results for a great variety of product range.

In CTS, each aisle has two lifts which are responsible for only either going up or going down separately. This decreases the waiting time in front of the lifts. In CTS, the shuttles are able to exit from the storage area in other words there is a flow available from the enter point of storage to the exit point. Thus, it increases not only the number of storage or retrieval transactions but also the shuttles do not need to come back to input/ output point again.

VI. Summary And Conclusion

This study, firstly, was designed to introduce the alternative warehouse system, CTS, and compare it with other two well-known storage and retrieval systems, AS/RS and AVS/RS, using an analytic method. In order to reflect the characteristic of real world situations, three company sizes are generated. The comparison between CTS, AS/RS and AVS/RS is enhanced by taking account of these diversified company structures. Also, scenario planning method is utilized to demonstrate which warehouse system should be chosen in response to different product amount and different product range.

The most obvious finding to emerge from this paper is that each warehouse system is appropriate for only certain scenarios and some storage configurations. In other words, neither of warehouse systems could be suggested to provide the reasonable cycle time for all company sizes and all storage structures. This study raises a number of questions for future research. Further work needs to be done by using throughput rate parameters in addition to cycle time. Also, it is recommended that further research be undertaken to measure the effect of the number of aisle, bays and tiers individually.

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An Approach to Develop Green Environment in Cement Industry by Proper Material Handling and Maintenance Management System- A Case Study

By Md. Al Amin, Himadri Sen Gupta, Rahnuma Tarannum & Rabiul Ahasan
Khulna University of Engineering & Technology

Abstract- Now a days with the huge industrialization material handling and maintenance management systems are going to be most crucial issues of any industry. Its importance cannot be denied in any way as a remarkable percentage of success of an industry depends on these. This article is based on the material handling and maintenance management system of a cement plant where their relevant systems were also studied. It was observed that the profit of any industry along with its working environment of any plant largely depends on the material handling and maintenance management system. In this research some remedial action were proposed regarding to the problems associated with material handling and maintenance management systems. Along with these the safety culture and proper training facilities of the employees were also researched for developing green environment within the cement industry.

Keywords: material handling, maintenance management, green environment, handling equipment.

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ANAPPROACHTODEVELOPGREENENVIRONMENTINCEMENTINDUSTRYBYPROPERMATERIALHANDLINGANDMAINTENANCEMANAGEMENTSYSTEMACASESTUDY

An Approach to Develop Green Environment in Cement Industry by Proper Material Handling and Maintenance Management System- A Case Study

Md. Al Amin [α], Himadri Sen Gupta [σ], Rahnuma Tarannum [ρ] & Rabiul Ahasan [Ѡ]

Abstract- Now a days with the huge industrialization material handling and maintenance management systems are going to be most crucial issues of any industry. Its importance cannot be denied in any way as a remarkable percentage of success of an industry depends on these. This article is based on the material handling and maintenance management system of a cement plant where their relevant systems were also studied. It was observed that the profit of any industry along with its working environment of any plant largely depends on the material handling and maintenance management system. In this research some remedial action were proposed regarding to the problems associated with material handling and maintenance management systems. Along with these the safety culture and proper training facilities of the employees were also researched for developing green environment within the cement industry.

Keywords: material handling, maintenance management, green environment, handling equipment.

I. Introduction

Material handling is the process of doing a job perfectly using the required amount of raw material at the perfect place to get the maximum output utilizing a perfect duration of time. Material handling consumes 25% of all employees, 55% of all factory space, 87% of production time and 15-70% of total cost of a manufactured product [1]. The measure work in material handling system design is the selection and synopsis of equipment. For that reason the selection of material handling equipment is really a complicated and tiring task [2]. In any way the importance of selection of material handling system cannot be neglected because it can alone improve the productivity and efficiency in a large amount of a system. There are lots of material handling equipment in this modern age but it is the most importance to select the most efficient material handling equipment to reduce both the cost of production and material handling. So a well - organized material handling system is very important to improve the production system in every aspect of an industry [3].

Author α σ ρ: Department of Industrial Engineering and Management Khulna University of Engineering & Technology, Khulna-9203, Bangladesh. e-mail: alaminkuet01@gmail.com

Author Ѡ: Professor, Department of Industrial Engineering King Abdulaziz University, Jeddah, Saudi Arabia.

To select the material handling equipment an expert system, MATHES (MATerial Handling Equipment Selection) is used which works through a process of checking the feasibility of technological and economical aspect in the selection of an equipment. MATHES selects the following types of equipment:

i. Manual- No equipment
ii. Pallet jack
iii. Platform truck
iv. Towing tractor
v. Trolley conveyor
vi. Power and free conveyor
vii. Tow conveyor
viii. Self-Powered Monorail carrier
ix. E- crane
x. Automated Guided Vehicle

Without these MATHES uses many other types of material handling equipment [4].

If any problem causes in selecting an appropriate material handling system it results in decreasing the productivity, increase both the movement of material and production cost. The proper maintenance management is also necessary for the equipment used in material handling and also in production site. Maintenance is such a process which helps an equipment to work without causing any breakdown at its normal operating condition by utilizing the full efficiency. There are different types of maintenance management system such as

i. Breakdown maintenance: In this type the system remain idle till it faces any problem. So it can be said that it is used in the case of emergency failure.
ii. Planned maintenance: This system is totally organized to control a work. The factors which are included here are equipment utilization, conditions of work and equipment performance.
iii. Scheduled maintenance: Here the equipment is prepared according to the schedule management of the production department.

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iv. Preventive maintenance: This system runs through routine attention, routine examination, preventive replacement and inspection measurements.
v. Condition based maintenance (CBM): This type is used where the capital is high for equipment as it ensures safety and availability.
vi. Reliability centered maintenance (RCM): RCM helps to find a logic behind the failures, such as safety, environmental, operational or non-operational, to state remedies for them.
vii. Corrective maintenance: This type of maintenance system is used to stop the iterative failure of equipment.

And according to different requirement of the industries, equipment and costs those maintenance systems are used [5]. As maintenance work is the vital task of any industry, maintenance and operations department is the largest in any industry and most of the time in comprises 30 % of total manpower and also a large amount in the operational budge [6]. In the manufacturing industries the functions of maintenance management system is more critical because without properly maintained equipment, the plant can be in disadvantage in the market. So maintenance of every equipment plays a vital role in production and also quality because an equipment with continuous fault nature cannot produce best quality product [7]. The main objective of this paper is to Develop Green Environment in Cement Industry by Proper Material Handling and Maintenance Management System. This paper is organized as follows: In Section 1, the main research topic is introduced with a brief literature review. During Section 2, the description of the problem is described based on which the research is conducted and in Section 3, the required raw materials of cement production plants are introduced. Section 4 illustrates a brief overview of the plant which was studied during the research. Section 5 represents the methodology of the work in some steps, the results of this research are discussed in Section 6 and finally we conclude in section 7.

II. Problem Statement

Environment of a cement industry is always dusty and noisy. Most of time dust content in the air cross the critical limit. Not only dust bust also CO_2 emitted from the concrete manufacture site hampers the normal activity of the environment and from the previous study 10% of total carbon emission are happen in this way [8]. For that reason, worker faced a lot of mental and physical problems in their workplace. During unloading raw materials and storing it, lots of raw material waste due to the lacking of proper material handling system and lack of workers' awareness. The dusty environment creates also because of the problem of correct maintenance management. Basically there are four raw materials in different percentage for manufacture cement in the industries which are clinker, lime stone, gypsum and slag. Among those it is more critical to handle slag and clinker. It was examined that a large amount of slag and clinker were destroyed at the time of unloading which not only causes loss of production but also hampers the green environment in those area. Besides some problem had been detected in the inside area of production. This was due to the lack of the maintenance management during handling the required equipment of production. Though the cement production system is an energy intensive process, it was found that in some areas the maintenance of energy consumption was not in the proper way [9-10].

III. Overview Of The Raw Materials Studied

Cement can be define a concrete or a binding element or agency. It is such type of powder that is frequently used to cling objects and is made by burning the powder of alumina, silica, lime, iron oxide and magnesium oxide and then pulverizing them. And the production of cement is not a new idea at all. In 19th century the industrial production of cement was started with shaft kilns and now which is replaced by a lots of new and moderate equipment. Those equipment increases the production in many times and now the cement production has touched 2.8 billion tons of annual production in worldwide [8]. There are various types of cements used in the industries such as:

Rapid Hardening Cement: A remarkable amount of lime content included here. It is used in the early stage to increase the strength.

Quick Setting Cement: According to its name this type is used to complete the binding work in a very short period which is done by the reducing percentage of gypsum.

Low Heat Cement: It is generated by minimizing the amount of tricalcium aluminate which is used in producing a large amount of concrete construction.

Sulphates Resisting Cement: In this type the amount of tricalcium aluminate is kept under 6 % percent to minimize sulphates' dominance.

White Cement: It is a costly cement mostly used in architectural work. Its raw materials exclude iron oxide.

In most of the case limestone, clinker, gypsum and a very small amount of slag is used as the common raw materials of cement production.

Limestone: Limestone is a type of alluvial stone that is formed by the sea snails shell made of calcium. One of the most important material lime which is a must in cement production can be found from it. By burning the limestone in lime kiln lime is usually produced. Lime is such an element which permits vapour which reduces the possibility of moisture trapping and make the cement environment friendly. It helps to bind objects early with exceptionally durability. The aesthetic demand is also fulfilled by it along with a self-healing quality. So it adds a lot to cement quality.

Clinker: The word clinker has come from "klinker", a Dutch word. It is a hard brick made from the ash and remainder of coal which is partially lost. The main raw of clinker is calcium oxide (65%), silicon oxide (20%), alumina oxide (10%) and iron oxide (5%) along with some tri-calcium aluminates and calcium alumina-ferrite.

A rotary kiln is used to produce clinker where the raw materials are crushed and mixed up at 2000 degree Celsius. The temperature at the other end of the kiln is 100 to 200 degree Celsius where the mixture comes automatically as it is incline and quick cooling is done.

Gypsum: $CaSO4 \cdot 2H2O$ is popularly known as gypsum.

It is the most common mineral of sulphate which is widely used in plaster. It is an important part of cement as it controls the rate of hardening and the setting process of cement. At the time of final grinding of clinker a small amount of gypsum is mixed with it and if it is not done the cement give no time to set after mixing the water.

Slag: While refining various metals from there ores some wastes are found which are like stone. This are known as slag. Mainly the slag from the iron ore is used in cement production. It improves the workability of cement reducing the risk of cracking. At the same time it also reduces the energy consumption of cement production.

IV. Overview Of The Production Plant Studied

The cement factory, which was visited, is Fresh Cement. It is a branch of Meghna Group of Industries which was established in 1976. The group started cement manufacturing in 2002 under the name of Fresh Cement and now it has become the second largest cement producer in Bangladesh. The art of manufacturing facility of Fresh Cement Industry is based on the latest German PLYCOM Technology. It was found that they have a very well established quality control and quality assurance facility where they use Bland test, Residue test, Calcium Oxide test, LOI, IR, Alumina Test, Alkali test, Silica test etc. To check the physical quality of cement they always check initial setting, final setting and its strength in ASTM, EN, BIS standards. It was observed that the technology used in Fresh Cement was quite different from other technologies for the following criteria:

Table 4.1: Distinguish characteristics of Fresh Cement

Grinding equipment	Electrical energy used Kwh/Tn (To produce 3500 sq cm/gm)	Grinding efficiency (Breakage energy with respect to consumed energy)	Residue(Sieve opening μ 45) (Contributes high ultimate strength)
Ball Mill	35-38	5% - 8%	7% - 10%
Vertical Roller Mill (VRM)	27-30	7% - 15%	4% - 5%
POLYCOM	22-26	12% - 20%	< 2.5%

The cement industry which was visited basically produce 3 types of cement. The description of those are given below:

Fresh Band Portland Composite Cement is an eco-friendly GREEN CEMENT manufactured in the fully automated state of the art manufacturing facility based on the latest German POLYCOM Technology, under strict quality control and quality assurance action plan.

The composition found in that cement is clinker (65-79%), gypsum (0-5%), slag, fly ash and lime stone (21-35%). There are lots of advantages which can be found in this type. Some of them are higher durability, better workability, low heat of hydration and better surface finish. The compressive strength test of that cement was done according to ASTM method and specification using standard sand. The result of the test is given below for three different duration:

Table 4.2: Test results in three different duration

3 Days (psi)			7 Days (psi)			28 Days (psi)		
Standard	Actual	Higher by	Standard	Actual	Higher by	Standard	Actual	Higher by
Min. 1890	2700	45.50%	Min. 2900	4120	42.07%	Min. 3620	5820	53.86 %

Fresh Special Brand Portland Composite Cement, which is another eco-friendly GREEN Cement that is also manufactured in POLYCOM Technology. The composition found in that cement is clinker (80-94%), gypsum (0-5%), slag, fly ash and lime stone (6-20%). Its application is like the previous but it is more efficient for mass concrete work-dam, high rise building, marine work and also masonry work. The same test which is compressive strength was done for this cement. The result of the test is given below for three different duration:

Table 4.3: Test results in three different duration

3 Days (psi)			7 Days (psi)			28 Days (psi)		
Standard	Actual	Higher by	Standard	Actual	Higher by	Standard	Actual	Higher by
Min. 1890	3810	100%	Min. 2900	4850	67.24 %	Min. 3620	6040	66.85%

Fresh Super Brand Portland Cement is another type of cement which is manufactured in fully automated state using the same technology, under strict quality control and quality assurance action plan. It is manufactured by only two raw materials such as clinker (95-100%) and gypsum (0-5%). It has several advantages:

1. Produces highly durable and sound concrete due to very low percentage of alkalis, Chloride, Magnesia
2. Almost negligible chloride content results in restraining corrosion
3. Significant saving in cement consumption

The most efficient use of this cement is in high rise building, bridge, fly over and also for heavy defence structure like bunker. And here the same test was done as before. The result of the test is given below for three different duration:

Table 4.4: Test results in three different duration

3 Days (psi)			7 Days (psi)			28 Days (psi)		
Standard	Actual	Higher by	Standard	Actual	Higher by	Standard	Actual	Higher by
Min. 1740	4510	159.20%	Min. 2760	5560	101.45 %	Min. 4060	7000	72.41%

V. Methodology

a) *Identification of the problems*

There are lots of cement factories in Bangladesh which export different types of cement in different portion of the world. Among those Fresh Cement is renowned one that was examined for this article. By combining the system of each unit of the factory the final product, cement is produced here. It was found that different unit of the plant faces different types of problem which was not only causing loss to the total production system but also hampering the health and safety issues of the workers and employees.

During unloading the raw materials at their own dock, huge dusty environment was seen and packaging unit also contained dust above the critical limit. For the dust produced in the production area and during limestone heating, percentage of greenhouse causing gasses like carbon-dioxide, sulphur dioxide, nitrogen oxides etcetera increases in the air that increases the temperature of the environment. This change hampers the regular work efficiency of the workers in the plant. Some sample were taken to understand the amount of wastages of raw material which are given it the table below:

Table 5.1: Percentages of Raw Material Wastages Identified

Sample (Day)	Raw materials sent from supplier (Metric Ton)	Successfully unloaded raw material (Metric Ton)	Amount of raw materials wastage (Metric Ton)	Percentage of raw materials wastage (% in Metric Ton)
1	7500	7499.022454	0.977546	0.013033947
2	8000	7999.100325	0.899675	0.011245938

3	6500	6499.098316	0.901684	0.013872062
4	9000	8999.005684	0.994316	0.011047956
5	9500	9499.065325	0.934675	0.009838684
6	8000	7999.000356	0.999644	0.01249555
7	8500	8499.056479	0.943521	0.011100247
8	6500	6499.124641	0.875359	0.013467062
9	6000	5999.023156	0.976844	0.016280733
10	7000	6999.023146	0.976854	0.013955057
11	7500	7499.098369	0.901631	0.012021747
12	9500	9499.032564	0.967436	0.010183537
13	10000	9999.189756	0.810244	0.00810244
14	6000	5999.258946	0.741054	0.0123509
15	8000	7999.045975	0.954025	0.011925313
16	8500	8499.025896	0.974104	0.011460047
17	8500	8499.000545	0.999455	0.011758294
18	7000	6999.006598	0.993402	0.014191457
19	6000	5999.002568	0.997432	0.016623867
20	9000	8999.025648	0.974352	0.010826133
21	9500	9499.006987	0.993013	0.010452768
22	10000	9999.021546	0.978454	0.00978454
23	7500	7499.025136	0.974864	0.012998187
24	8000	7999.128648	0.871352	0.0108919
25	8500	8499.000564	0.999436	0.011758071
26	7500	7499.098564	0.901436	0.012019147
27	6000	5999.012119	0.987881	0.016464683
28	6500	6499.093516	0.906484	0.013945908
29	8000	7999.003621	0.996379	0.012454738
30	8500	8499.025135	0.974865	0.011469

The factory has a regular maintenance system which supervise the whole production but it is not so much capable of maintaining it perfectly which results in some loses. It was rather noticed that in some area of the production unit scheduled maintenance were followed which was not appropriate. Thus it causes a loss.

It was seen in the plant that some leakage took place on the body of production equipment which wastes a lot of raw material. So ultimately it also causes loss of production capacity. The target capacity found 12000 ton/day but because of this problem the target capacity could not be reached. As a result it causes both economical loss and environment pollution.

b) Definition of the problems

Dusty environment: Dust is a common air pollutant generated by many different sources and, activities done continuously in the plant area. The particles of dust can vary in size from visible to invisible and it was found that in the plant area smaller particles stay longer in the air which moves around. The environment with contains such amount of dust is defined as dusty environment.

Maintenance problem: The problem which effects the increasing production strategy of the industry and by proper maintenance which can be solved are known as maintenance problem. The problem mainly arise for the wrong selection of maintenance management system.

Material handling problem: The problems which are associated with the handling of different raw materials and also finished or semi-finished goods. This is a vital problem in any industry or plant where huge amount of finished goods are produced regularly.

c) Mitigation strategy for the problems identified

Lessening the Waste of Raw Materials: Some small steps can solve many major types of problems. First of all the problem facing during loading and unloading was found which cause of the waste of huge amount of raw material. The result of the research showed that numbers of small steps can mitigate this problem. By attaching some sensor like and bringing some change in the structure of a clinker discharging vessel, the loss of raw material can be decreased in a considerable amount. Basically as sensor here motion sensor and distance sensor were used as an experimental view. Mainly two sensors were used concurrently to sense the motion of the E-Crane and distance of it from the discharging vessel. The entrance path of the discharging vessel was made of light composite material and was controlled entirely by the sensors. Both of sensors were connected with each other and worked simultaneously. Here distance sensor was examined by attaching it with the entrance path of the discharging container whereas motion sensor in the head of E- Crane.

Let,

the distance between the head of E-Crane and entrance of the discharging vessel, D= 3m

Required time to open the entrance of the discharging vessel, T=10 sec

Safety Time for the whole opening system, t= 10sec

Velocity of the head of E-Crane =V

So,

$D=V (T + t)$ m

or, $V=D/ (T + t)$ m/s

or, $V= 3/ (10 + 10)$ m/s

or, $V=0.15$ m/s

When the head of the E-Crane comes at the distance of 3 metre of the entrance, the distance sensor works and opens the entrance door of the discharging vessel. If the speed of the head of the E-crane is 0.15m/s or lower than that, then the distance sensor will work. Otherwise at the increment of the speed then.15m/s the motion sensor will work with the help of distance sensor and open the entrance according to the required distance. Let the variable velocity of the head of E-Crane, V is x. Then,

$D=V (T + t)$ m

or, $V = D/ (T + t)$ m/s

or, $x=D/ (T + t)$ m/s

Remedial Action for the Problems Associated with Maintenance Management: As the plant has numbers of units for production of cement, the maintenance of the equipment's of every unit are so much crucial. But maintenance management system not only causes huge expense but also the total manufacturing efficiency depends on it. After that the entire system of units totally affected in the absence of proper maintenance which was identified in the last stage. But by opting some proper way of maintenance it can be brought in a profitable path. Scheduled maintenance, a plan of maintaining equipment, requires higher cost. Along with having a lot of advantages, it has a number of disadvantages too. It was not so much vital for every unit of a plant to maintain scheduled maintenance system. For the unit of Roller and Ball Mill, it was observed that huge dust contained in the air with a large amount of cement in the body of different equipment which was due to the leakage of any equipment. So breakdown maintenance have to be established there to mitigate all of those problems instantly instead of waiting for further scheduled checking action which reduce the waste of raw material and also manufactured cement. In case of scheduled maintenance it is very important to use "Non Destructive Testing" (NDT) which can help a lot to find any types of cracks or leakages on the entire outer surface of the equipment. In case of tasting equipment's surfaces, fluorescent penetrant inspection, ultrasonic testing and radiography were used which is a way of maintenance management. Fluorescent penetrant inspection was used to check cracking of many parts. It had been tested that the result of ultrasonic is far accurate then radiography and so for getting more confirmation it was used too.

Providing Proper Training Facilities to the Employees: In the modern age of industrialization, most of the technology applied in different works are so much advanced. For that reason, it is very crucial to make the workers efficient to use all of the technologies. And the most vital thing is that remedial actions involved in different industrial problems are highly advanced. For applying those remedial actions by using proposed technology, some special training is must where both short range and long range training can be given. In most cases, training can be organized by inviting expertise from outside who can give sufficient knowledge about the uses of proposed technology. To use the sensors which is proposed to attached in the body of the head of E-crane and in the entrance of discharging vessel, short range training is so much vital because without proper use of it, all effort will go in vain.

The lack of proper use of any technology can hamper the productivity and due to these proper training is so important. Apart from short range training, there are some other training facilities such as apprentice training, concurrent training passive training which can also help to make workers fit to use all of the new technologies.

Ensuring Safety Culture within the Cement Industry: Safety culture is an utmost factor of a cement plant. It is a matter of attitude and belief that the employees and workers share among themselves. For a good safety culture a proper management is needed who will observing through the working hours and ensure all the related things about the safety of each and every personnel of the industry different types of hazardous situation can occur at any time. Machinery and equipment should be maintained regularly to minimize risk. The workers should be trained on the quick heal of the machines rather than depending on the regular inspections. A machine should not be used if it is deemed potentially unsafe. Every worker should be aware of the limitations of their used equipment. It is a most important issue to have a trained first aid employee in urgent cases. Along with this workers should be given a bird's eye view on first aid. Last but not least matter is the danger area of the industry which should be clearly restricted for the normal workers and employees. Only the trained workers should have the access there.

VI. Result & Discussion

Cement is a vital element of the new era without which no construction can be build up. As a result many types of cement are being produced in different industries throughout the world which hold different quality. The research work was done by studying one of the most renowned cement industries in Bangladesh named Fresh Cement Industries Limited which is a part of Meghna Group of Industries. From the beginning of raw materials of cement to material handling of whole production system was observed. In that observation numbers of problems was identified inside the production area which were solved by this work. The wastage of raw materials was reduced by using our proposed solution which was confirmed by sampling data of raw materials unloading.

Table 6.1: Percentages of Raw Material Wastages after Mitigation

Sample (Day)	Raw materials sent from supplier (Metric Ton)	Successfully unloaded raw material (Metric Ton)	Amount of raw materials wastage (Metric Ton)	Percentage of raw materials wastage (% in Metric Ton)
1	8000	7999.788234	0.211766	0.002647075
2	7000	6999.834322	0.165678	0.002366829
3	9500	9499.645678	0.354322	0.003729705
4	6000	5999.443456	0.556544	0.009275733
5	7500	7499.945290	0.05471	0.000729467
6	8000	7999.743623	0.256377	0.003204713
7	5500	5499.845324	0.154676	0.002812291
8	7000	6999.674917	0.325083	0.004644043
9	9500	9499.467229	0.532771	0.005608116
10	7500	7499.872313	0.127687	0.001702493
11	8500	8499.786456	0.213544	0.002512282
12	7000	6999.879443	0.120557	0.001722243
13	9500	9499.865798	0.134202	0.001412653
14	8000	7999.989870	0.01013	0.000126625
15	8500	8499.768569	0.231431	0.002722718
16	9000	8999.645877	0.354123	0.0039347
17	7500	7499.768564	0.231436	0.003085813
18	8000	7999.768765	0.231235	0.002890438
19	6500	6499.689746	0.310254	0.004773138
20	6000	5999.867585	0.132415	0.002206917
21	9500	9499.897897	0.102103	0.001074768

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22	7000	6999.567676	0.432324	0.006176057
23	8500	8499.768568	0.231432	0.002722729
24	9000	8999.787677	0.212323	0.002359144
25	10000	9999.878675	0.121325	0.00121325
26	6500	6499.786586	0.213414	0.003283292
27	6000	5999.897868	0.102132	0.0017022
28	5500	5499.786869	0.213131	0.003875109
29	8500	8499.776864	0.223136	0.002625129
30	9000	8999.657578	0.342422	0.003804689

The Table 6.1 shows the rate of percentage of successfully unloaded raw materials is higher than it was previous. Hence the amount of raw materials wastage greatly reduced at the very beginning of the main production starts. As we can say from the table that is in sample day of 1 the amount of raw materials wastage has been reduced to 0.01303% to 0.00264% in Metric Ton. Similarly it is clearly noticed that the wastage of raw materials reduced 40% to 60% in every sample day is observable. So, the percentages of raw materials wastage has been reduced in conspicuous rate after applying the proposed solution to the entire plant.

As the air of the plant was mostly polluted due to the dust of raw material which were wasted in the time of unloading and that increase the CO2 content in the air , by solving the problem of raw material waste the problem of CO2 percentage in the air also reduced. Before starting this work the Carbon-di- Oxide content was found in the plant area was found about 2.074% where normal carbon-di-oxide should be 0.0314% but after opting all of the proposed systems it is decreased to 0.0989%.

Optimized maintenance management system was introduced to the plant and by which it was seen that the cost relating to maintenance was reduced. Most importantly safety issues were also studied and most effective training were suggested to the plant. After all of those treatment has been taken it was ensured that the production loss of the plant is reduced with ensuring green environment inside the entire plant.

VII. Conclusion

The development of the green environment within the cement industry is essential for the betterment of industry itself and its employees. In the economical perspectives of Bangladesh, cement industries play very crucial role. So the process of cement production, industrial environment and their safety is too vital. At the very beginning of the production system the main things to deliver the raw material into the process very swiftly. At that time if we lose the raw material, production loss will begin before starting the main production. The main target of the this research was to reduce the waste of raw materials before starting the production by using appropriate material handling system in the right place. Proper maintenance management systems was ensured inside the production area which was another research outcome. Providing safety training and ensuring safety culture within the industry can also play the great role in developing green environment.

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Coupling of Texturing/Cooling using Instant Controlled Pressure Drop and Transesterfication for Biodiesel Production from Camelina Sativa

By F. Bamerni, I. Kamal & K. Allaf
Zakho University

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Coupling of Texturing/Cooling using Instant Controlled Pressure Drop and Transesterfication for Biodiesel Production from Camelina Sativa

F. Bamerni [α], I. Kamal [σ] & K. Allaf [ρ]

Abstract- Although Camelina Sativa as oleaginous seeds has obvious advantages as a feed of wonder health benefits, it has been recommended as a highly promising environmental sustainable energy crop and a perfect source of biodiesel. The current work deals with the industrial significance of intensifying the oil and biodiesel yield from Camelina seeds by incorporation of a pretreatment stage for raw material texturing using Instant Controlled Pressure-Drop (DIC) process. The texturing process proved to promote the yield of oils produced by pressing the seeds, and extraction the seeds using solvent, by an amount of 75.9 and 82.9 kg oil /1000 kg seeds, respectively compared to the raw untreated seeds. Consequently, the transformation of the oil using conventional transesterification and in-situ trancesterification reactions showed similar trend for increasing the level of biodiesel yield by 86.58 and 155.8 kg/1000kg seeds from conventional transesterification and in-situ transesterification, respectively after texturing the seeds by DIC at 5 bars saturated steam for 40s. The promising findings of the current work could be considered as an innovative approach for cost effective biodiesel production for industrial purposes.

Keywords: biodiesel; in-situ transesterification; instant controlled pressure drop; optimization.

I. Introduction

During the last century, the consumption of energy has greatly increased due to the change in the life style and the significant growth of population. This increase of energy demand has caused growing emissions of combustion generated pollutants and, simultaneously, the scarcity of conventional fossil fuels [1]. This induces increasing extraction costs and makes alternative energy sources more attractive [2]. Biomass is considered as one of the most promising alternative sources of energy that would be economically efficient, socially equitable, and environmentally sound. To meet the rising energy demand and replace reducing low-cost petroleum reserves, biodiesel is in the forefront of alternative technologies [2].

Despite the large fall in price of fossil fuels, there have been substantial increases in biodiesel production in recent years, and this trend is expected to continue [3]. For example, U.S. Biodiesel production during December 2016 was 1 million gallons higher than production in November 2016, it reached 143 million gallons in December 2016. To compare between the three years ago, biodiesel productions in 2014, 2015 and 2016 were 1271, 1268 and 1566 million gallons respectively [4].

Biodiesel can be produced from a great variety of feed stocks. These feed stocks include most common vegetable oils, animal fats and waste oils. The choice of feedstock depends largely on geography. The routes of biodiesel production is dependable on the origin and quality of the feedstock [5].

The archaeological excavations in Europe have revealed the existence of Camelina sativa as far back as 1500 B.C., however, it is a new crop for the western United States, where cultivation began in the 1980s [6,7].

Biodiesel production from Camelina seeds can be classified as a new-generation or a more relevant type of second generation of biodiesel. Camelina's feed potential and its competition with feed grains is limited because Camelina is high in euricic acid and glucosinolates, these two main anti-nutritional factors limits the amount of Camelina meal that can be fed. Hence, Camelina has more potential for production with less competition with other feed and food crops. Also, land used to grow Camelina, even fallow land, may positively impact that land's productivity for later food production [7].

Camelina possesses important agronomic traits that recommend it as an ideal production platform for biofuels and industrial feed stocks [8]. Camelina is promising sustainable alternative energy crops because it possesses a short-season crop and can be grown as a crop twice during the year under different climatic and soil conditions with the exception of heavy clay and organic soils [9-11]. Interest in Camelina sativa has been renewed due to the fact that the crop does not require high inputs of nutrients and pesticides. It grows [12]. Moreover, Camelina needs little water and does not compete with food crops. As a relevant way to improve the health of the soil, Camelina may be used as a rotation crop for wheat [13]. Camelina has also being

Author α: Chemistry Department, Zakho University, Kurdistan Region, Iraq.
Author σ: Soran University - Kurdistan Region, Iraq.
e-mail: ibtisam.kamal@soran.edu.iq
Author ρ: University of La Rochelle, LaSIE UMR-CNRS 7356, France.

researched as a fall-seeded cover crop within soybean and sunflower, the double crop yield returns were higher compared to the mono cropped counterparts [8].

The main product of Camelina sativa is the oil. The oil content of Camelina seeds ranged from 29.9 to 38.3% [12,14], however values as high as 48% have been reported [15]. Table 1 listed the oil yield from several oil bearing seeds.

Table 1: Comparison of yields from several oilseeds[16]

	Camelina	Rapeseed	Soybean	Sunflower
Seed Yield (tons/ha)	0.90-2.24	2.68-3.39	2.14-2.84	1.44-1.70
Oil Content (wt. %)	35-45	40-44	18-22	39-49
Oil Yield (l/ha)	106-907	965-1342	347-562	505-750

Camelina biodiesel system starts with planting, followed by harvesting and crushing the seeds. This results in two major products; Camelina meal and oil. The meal is fed to livestock, and the oil is processed into biodiesel [7].

It is worthy to note that fuel obtained from renewable and eco-friendly sources has low contain of sulfur and aromatics, and is totally biodegradable [17]. The optimized biodiesel from Camelina met the related ASTM D6571 and EN 14214 biodiesel standards. They are comparable to those of the regular petroleum diesel fuels and can be used for diesel engines as qualified fuel [9,18].

Generally, biodiesel is made through transesterification of triglyceride in the natural oils with alcohol. The transesterification of vegetable oils or fats can be done in a simple process. There are different ways of biodiesel production, normally depending on the kinds of raw materials: refined, crude or frying oils. Transesterification is performed using different types of catalyst; basic, acids, ion exchange resins, lipases and supercritical fluids [19]. Thus, the process conditions must be carefully controlled to achieve optimal yield at the optimal temperature and reaction time [20].

Ideally, transesterification is potentially a less expensive way of transforming the large, branched molecular structure of bio-oils into smaller, straight-chain molecules of the type required in regular diesel combustion engines [2]. Oil usually used as raw material for transesterification process is habitually produced by solvent extraction or by mechanical pressing usually followed by solvent extraction to extract any remaining oil [21-23]. The efficiency of a mechanical-expression process rarely exceeds 80% [24]. Solvent extraction is more efficient, especially for oilseeds with lower oil contents such as soybeans. Seeds with higher oil contents are pre-pressed before extraction by solvent [25]. The majority of the output of the biodiesel production process is meal (in terms of weight and volume). Meal should be consumed as close as possible to the point of production to avoid transportation costs [7].

For improving technological aptitude of raw material in terms of extraction, one may modify the premier structure of the seeds. In our laboratory, modifying the raw materials is carried out by applying texturing and structural expansion using the Instant Controlled Pressure Drop (DIC) technology [26]. In terms of vegetal oil production, it had been proved that DIC-textured oleaginous plants could get about 10% higher oil yields. Also, the higher the expansion ratio, the better the diffusivity constant predicted. Oil transesterification is by far the most common method to produce biodiesel [5,27]

Although the reaction is not so energy-consuming and the conversion efficiencies are good [28], the operation is known as expensive because of the numerous steps between harvesting of oilseeds and final production of biodiesel after intermediate steps of oil extraction and refining [29]. The price of raw material can account for 65 to 75% of the cost of production of biodiesel. Increasing the yield has a great interest in improving the process and the economy and profitability of biodiesel production [28]. However, it has been reported that biodiesel yields were possibly reduced during conventional transesterification because of the existence of gums and extraneous material in the crude vegetable oil, hence, refining and purification of extracted oil become crucial stages before transesterification [30].

There is another way to produce biodiesel; that is 'in-situ transesterification'. This process combines the steps of lipid (oil) extraction/refining and transesterification in only one 'reactive extraction' step to produce biodiesel [21]. Nevertheless, industrial works and research studies claimed that in-situ transesterification produced lower yield of biodiesel than the conventional transesterification method in different percentages according to the raw material. However, ISTE is interesting because it greatly simplifies the process and makes it more suitable for distributed production [29], [31-33].

The current work aimed at defining various intensification routs of producing biodiesel based on using (DIC). Fatty Acid Methyl Esters (FAMEs) were manufactured by transesterification of oil produced by pressing and solvent extraction of the raw seeds, transesterification of pressed oil and oil extracted by solvent from DIC textured seeds, and in-situ transesterification of raw and the DIC-textured seeds.

II. Material And Methods

a) Raw materials

Dried Camelina Sativa seeds were provided by Sanctum Mediterranean harvested from France fields (Les Combes, 30250 Junas). Methanol 99.9%, toluene 98%, anhydrous Sodium phosphate, n-Hexane (HPLC grade, 99.9) were purchased from Merck. Sulfuric acid 99% from Sigma-Aldrich.

b) Measurement of moisture content

Camelina Sativa seeds were sun dried. The moisture content of the samples was measured by IR moisture analyzer (MB 45, Infrared halogen Moisture Analyzer. OHAUS -Switzerland), and by oven method (105 °C for 24 hours). The initial water content of the dried Camelina seeds has been determined to be 0.0443 g H_2O/g db. The safe moisture content for storage of oilseeds decreases with increase in oil content of the oilseed [34]. Camelina seeds moisture should be not more than 8% for best storage. Maximum oil contents also based on moisture content [34-38].

c) Instant controlled pressure drop technology

Instant controlled pressure drop (DIC) technology was initially developed by ALLAF and collaborators, (Since 1988) at the University of La Rochelle. It applies an instant pressure drop to modify the texture of the material and intensify functional behavior [39]. Instant controlled pressure drop DIC is a High-Temperature, High Steam Pressure (ranged between 0.1 and 0.7 MPa)/Short-Time (usually between 5 and 60 s) treatment followed by an abrupt pressure drop towards a vacuum (about 5 kPa) [40,41]. A schematic diagram of DIC set-up is shown in Figure 1.

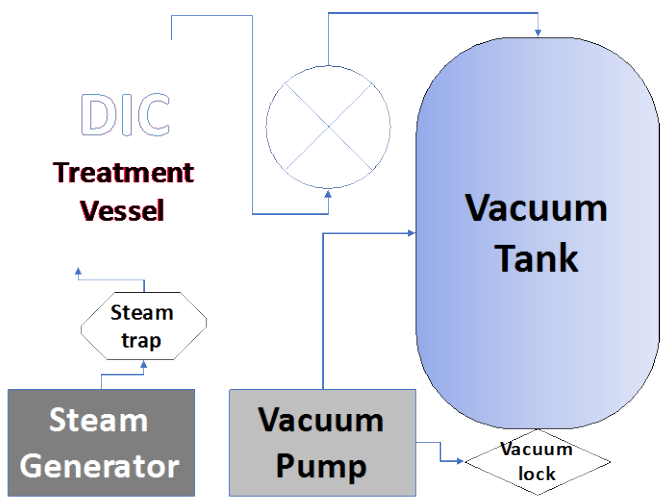

Figure 1

1.1.1.1. Figure 1: Schematic diagram of DIC unit: The treatment vessel where we place and treat the samples. The vacuum system, which consists mainly of a vacuum tank with a volume 130 times greater than the processing reactor, and a suitable vacuum pump. The initial vacuum level was preserved at 50 kPa in all the experiments. A pneumatic valve assures the connection/separation between the vacuum tank and the processing vessel. It can be opened in less than 0.2 seconds, this ensures the abrupt instant pressure drop (□P/□t>0.5 MPa/s) within the reactor.

DIC is distinguished by a pressure-drop rate higher than 0.5 MPa/s implying an expansion and a rapid cooling of the product [40]. The pressure drop controlled destruction of cell walls; it also may release volatile compounds [42].

The high temperature of the process is generated by subjecting the raw material for a short time-frame to saturated steam high-pressure [43], This generates an auto-vaporization of volatile molecules, implying instant cooling and expansion of the sample. DIC allows the structure to be more expanded [43] and usually preserves the product color, flavor and vitamins; it also decontaminates and gets rid of insects. Therefore DIC treated products have normally a minimum shelf life of two years [40]. In addition, texturing by DIC results in increasing operation performances through lower energy consumption and processing time [40]. It allows undertaking much more effective solvent extraction through higher effective starting accessibility and diffusivity, which greatly reduces processing time [43].

d) Extraction of oil from Camelina Sativa

i. Mechanical pressing

Pressing is the most common method in the world to separate oil from oils oilseeds on small to medium level [44].

To obtain the Camelina Sativa oil by pressing, a mechanical screw press (Täby Örebro, Sweden) was used. The restricted size of the press cake outlet can vary by placing different sized nozzles (7 mm) to get the best results in terms of extracted oil. After pressing the pressed cake was analyzed for oil content.

ii. Solvent Extraction for Camelina cake and Seeds

Oil extraction from Camelina seeds as well as cakes produced by pressing was achieved by reflux apparatus using n-hexane. Processing conditions were estimated from the literature [11] with some modifications: seeds/solvent ratio 1:26 (w/v), and extraction temperature 60 ± 2 °C. Extraction time and agitation speed were selected to be 2 hours, and 600 rpm, respectively. Percentages of oil extracted from the seeds and the cake are listed in table 2.

e) Experimental design

Statgraphics for Windows software (5.1 version), SIGMA PLUS Neuilly/Seine (France) for designing experiments and statistically treating the responses was employed. 2-parameter 5-level central composite designs was adopted to study the effect of DIC operating parameters on biodiesel (FAMs) yield. 13 DIC-textured samples were transesterified using the optimized conditions estimated from response surface analysis (RSA) for data based on ISTE of the raw Camelina seeds.

f) Conventional and in Situ Transesterification

Transesterification (TE) of Camelina oil, and In-Situ Transesterification (ISTE) of Camelina seeds were carried out based on experimental design using Response Surface Methodology. The main response (dependent variable) was the yield of biodiesel. Sulfuric acid was used as the catalyst in the two processes. The optimum conditions used in the conventional transesterification (TE) process were: reaction time (36.24) min., solvent/oil volume ratio (17:1), and catalyst to solvent volume ratio (2:100). The transesterification processes were carried out at constant temperature (60 °C) and agitation (600 rpm).

The optimum conditions adopted for In-Situ Transesterification (ISTE) process were: solvent/seeds ratio (volume to weight 50:1), and catalyst to solvent volume ratio 10:100. The in situ transesterification reactions were carried out at constant temperature (60°C) and agitation (600 rpm). The In-situ transesterification process was performed under the following conditions: solvent type is Methanol: Toluene (90:10) v/v, catalyst type H_2SO_4 mixed with methanol (4%, w/v), and reaction time 2 h. Each experiment started by preparing separately a reactive mixture with adequate amounts of solutions of methanol/toluene, and acid catalyst in a 500-mL round bottom flask with reflux condenser, the mixture was heated using a magnetic stirrer hot plate. The mixture was shaken until the catalyst was completely dissolved, and at the same time, pre-heated to the desired reaction temperature (60 °C). A predetermined amount of Camelina seeds according to the experimental design was soaked in 10 ml of the reactive mixture for 10 min., and then charged to the round bottom flask when methanol/catalytic solution had reached the desired temperature. After the reaction completion, the round bottom flask was cooled to room temperature, and then the cooled mixture was filtered.

The solution was transferred to a separation funnel to allow separation of glycerol from the ester phase. After separation, the crude biodiesel was washed 4-5 times with warm distilled water followed by 0.1 % sodium hydroxide to remove trace amounts of catalyst in the methyl ester. The washing was repeated until a clear water layer of neutral pH was obtained. The solvent was evaporated using rotary evaporator (55-60°C). The obtained FAMEs (i.e. biodiesel) were dried over anhydrous sodium phosphate then filtrated to remove the sodium phosphate. Finally, the FAMEs was collected with molecular sieves to make sure getting rid of the remnants of moisture in a dark glass container and kept in the refrigerator. The biodiesel yield was calculated using Eq. 1:

$$Y(biodiesel\ yield)\% = \frac{Weight\ of\ biodiesel\ (g)}{mass\ of\ seeds(g)} * Lipid\ content\ (\%) \quad (1)$$

The DIC operating variables for the in situ transesterification reaction were treatment temperature, T and processing time, t. The coded and natural levels of DIC independent parameters are listed in Table 2.

Table 2: Real and coded values of DIC independent parameters (processing temperature, T and processing time, t)

Coded level	-α	-1	0	+1	+α
DIC processing temperature T (°C)	115.0	122.3	140	157.7	165.0
DIC Treatment Time t (s)	15.0	19.4	30.0	40.6	45.0

According to the experimental design (13 samples) of Camelina seeds were treated by DIC at different processing temperature and time. In general, DIC treatment involves initial heating of the fresh biomass and/or partially dried feedstock usually up to 160 °C using high-pressure (up to 0.8 MPa) saturated steam, in a treatment vessel for a short period of time (some seconds or dozens of seconds). Once the equilibrium at both temperature and water content within the product is attained, the second main stage is performed inferring an abrupt pressure-drop with a rate $\Delta P/\Delta t$ higher than 0.5 MPa s^{-1}, towards a vacuum (usually 5 kPa).

Since the porosity and texturing ratio are usually function of the amount of auto-vaporized water from the textured material, the rheological behavior and the glass transition temperature of the material depend on DIC temperature, vacuum level, and pressure drop rate, hence, the DIC vacuum level and pressure drop were kept constant at (3.5 kPa) and (65 MPa s^{-1}) respectively based on literature data [45] and after some preliminary experiments. A comparative study of ISTE for 13 samples of DIC-textured Camelina seeds was conducted. The DIC independent variables T and t were defined as 115.0-165.0 °C and 15-45 s, respectively as listed in Table 2. It is worthy to mention that the DIC treatment temperature is strictly correlated with the pressure of saturated steam.

III. Results and Discussion

Studies at laboratory scale were established to identify and quantify the impact of DIC parameters on yield of oil extracted from Camelina seeds. DIC operating conditions were optimized relevant to maximum oil yield. DIC processing parameters were heating treatment time t (between 15 and 45 s) and the saturated steam temperature T (between 115.0 and 165.0 °C) which corresponds to pressure P (between 0.17 and 0.7 MPa). The optimized processing parameters (157 °C or 0.58 MPa, and 41 s) were applied to identify the industrial significance of DIC process. Treatment capacity of the industrial scale DIC reactor was established to be about 8 tons/hour.

a) Comparative Industrial Yields of Oil

Using a mass input of 1000 kg Camelina seeds, a comparative study was performed for various processes on industrial scale : a. Conventional transesterification of oil extracted by pressing (PO-TE), b. Conventional transesterification of oil extracted by solvent (SE-TE), c. Transesterification of pressed oil from DIC textured seeds (DIC/PO-TE), d. Transesterification of oil extracted by solvent (DIC/SE-TE), e. In-Situ Transesterification (ISTE) of un-textured raw material, and f. In-Situ Transesterification (ISTE) of DIC-textured seeds. Transesterification was carried out on oil produced from pressing and that from SE (solvent extraction) of Camelina cake.

The amount of extracted oil from raw seeds and DIC treated seeds by pressing and solvent extraction as well as the increase in oil yield is shown in Table 3. The results estimated revealed that by applying the optimized DIC texturing pre-treatment (0.58 MPa for 41 s), the oil yields from both solvent extraction and pressing increased by an amount of 75.9 and 82.9 kg oil /1000 kg seeds respectively. However, the pressing followed by solvent extraction (SE) of meal for DIC-treated seeds allowed a total increasing of the oil yield of 50.9 kg/1000 kg seeds as shown in Table 3.

Table 3: Comparative industrial amounts of extracted oil by pressing and solvent extraction for 1000 kg Camelina raw and DIC treated seeds

	Amount of extracted oil RM (kg)	Amount of extracted oil from DIC-textured seeds (kg)	Increased in yield after DIC textured (kg)
Solvent extraction from seeds	352.5	428.4	+75.9
Seed pressing	218	300.9	+82.90
Solvent extraction (SE) from meals	88	56	-32.00
Total of pressing and SE of meals	306	356.9	+50.90

b) Comparative Industrial Yields of Biodiesel

The actual values of DIC independent parameters and responses (biodiesel; FAMs yield from TE and ISTE) experiments carried out at laboratory are shown in Table 4.

Table 4: Actual values of DIC independent parameters and responses (FAMS yield from TE and ISTE)

Sample/ No.	Treatment temperature (°C)	Processing time (s)	ISTE FAMEs yield (g/g dry seeds)	TE FAMEs yield (g/g dry oil)
Control	/	/	0.2594	0.9649
DIC1, 4, 7, 10,13	140	30	0.3790	0.9752
DIC2	165	30	0.3396	0.9991
DIC3	140	45	0.3263	0.9743
DIC5	157.7	41	0.4244	0.9981
DIC6	157.7	19	0.3537	0.9478
DIC8	122.3	19	0.3483	0.9977
DIC9	122.3	41	0.3391	0.9948
DIC11	115	30	0.3241	0.9862
DIC12	140	15	0.3152	0.9474

The experimental results confirmed that the DIC samples produced higher biodiesel yield from both conventional and in-situ transesterification processes compared to raw untreated Camelina samples, however a significant increase was identified for biodiesel produced by in-situ transesterification compared to conventional transesterfication as shown in Table 4.

The experimental yields were analyzed statistically by RSM. The response surface analysis results from ANOVA for biodiesel yields from TE and ISTE processes are summarized in Table 5.

Table 5: Summary of Response Surface Analysis results estimated from Analysis of variance (ANOVA)

Process	R^2 (%)	Optimum Conditions	Mathematical Model
TE	94.56	T; Time= 0.61 (h) S; Solvent/oil= 17/1 (v/v) C; Catalyst/ solvent = 2 %	FAMs yield = -1.86 + $0.38*T + 0.38*S - 0.091*C - 0.030*T^2 - 0.023*TS + 0.020\,TC - 0.010*S^2 - 0.013SC + 0.012*C^2$
ISTE	97.57	S; Solvent/ seeds =50/1 (v/w) C; Catalyst/solvent =10 %	FAMs yield = 12.36 + $0.17*S + 0.16*C + 0.0007*S^2 + 0.0009*SC + 0.007*C^2$

The high regression coefficient(R^2) for both TE and ISTE processes reflected that the adopted models have high capability to explain the experimental results accurately.

On the other hand, the significance of the operating parameters for conventional transesterification and in-situ transesterification reactions could be explained by the Pareto charts shown in Figures 2 and 3 respectively.

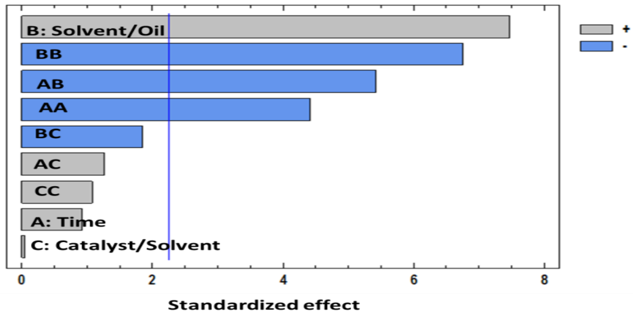

Figure 2: Pareto chart for the effects of conventional transesterification parameters on biodiesel yield

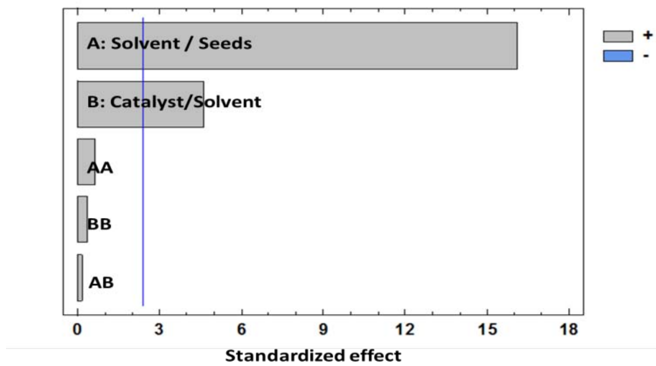

Figure 3: Pareto chart for the effects of in situ transesterification parameters on biodiesel yield

Based on Pareto charts, is obvious to note that solvent/oil ratio is the most significant parameters affected biodiesel yield followed by reaction time, while catalyst/solvent ratio shows no significant for conventional transesterification as shown in Figure 2. However, solvent/seeds ratio was also the top most significant for in situ transesterifications followed by catalyst/solvent ratio which show less significant effect (Figure 3).

A comparative study for industrial production of biodiesel using 1000 kg of Camelina seeds was performed in the current work. The industrial production of biodiesel from Conventional Transesterification TE of Camelina oil, and In-Situ Transesterification ISTE of un-textured raw seeds and DIC-textured seeds resulted in great difference in biodiesel yields as shown in (Table 5).

The optimized DIC parameters correspond to the optimum experimental results when applied to industrial scale resulted in a clear view for the industrial significance of the DIC process.

Table 6 shows the estimated industrial yields of biodiesel produced by TE and ISTE operations of 1000 kg of un-textured and DIC-textured Camelina seeds.

Table 6: Comparative Industrial yields of biodiesel from TE and ISTE operations using 1000 kg of the raw un-textured and DIC-textured Camelina seeds

	FAMEs from RM (kg)	FAMEs from DIC textured seeds (kg)	Increased in yield after DIC texturing (kg)
ISTE	247.3	403.1	155.80
TE	336.64	423.22	86.58

By incorporation of the optimized DIC texturing pre-treatment conditions, yields of biodiesel from both TE and ISTE increased as shown in Table 6. An increase in biodiesel yield of about 86.56 and 155.80 kg/ 1000g is produced from TE and ISTE respectively. Our findings are not in line with that recorded by other researches who reported that less amount of biodiesel is produced by ISTE compared to that produced by TE [46]. The result of the current work confirmed that when ISTE process is coupled with DIC treatment (DIC/ISTE) more biodiesel will be produced. The reason is attributed to structure expansion and texturing of the raw material by DIC which enhance the solvent diffusivity and extractability as well as the kinetics of the transformation process [43,47,48]..

IV. Conclusion

The current study is a comparative study for production of biodiesel; Fatty Acid Methyl Esters

(FAMEs) from Camelina seeds throughout different routes; conventional transesterification of oil extracted by pressing (PO-TE), conventional transesterification of oil extracted by solvent (SE-TE), transesterification of pressed oil from DIC textured seeds (DIC/PO-TE), transesterification of solvent extracted oil from (DIC/SE-TE), in-situ transesterification (ISTE) of un-textured raw material and in-situ transesterification (ISTE) of DIC-textured seeds. The conclusions could be drawn from the current study revealed that coupling DIC texturing with transesterification, of the raw material will resulted in intensification of the transformation processes to promote the FAMEs yield by 86.58 and 155.8 kg/1000kg seeds by conventional transesterification and in-situ transesterification respectively. The findings are of potential importance from industrial point of view in term of cost effective biodiesel production.

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Predicting Waiting Time under Deferent FCFS Queue Schemes

By Ibrahim Bedane
Madda Walabu University

Abstract- This paper model the phenomenon of waiting in lines and predict Expected queue length, and waiting time in queue of kth customer arrive at any time x based on Cumulative Approach Analytical Technique (CAAT) to inform customers on the system state at the time of estimation. Using Modeling Technique developed and cumulative Arrival and service data collected up to time x, functions approximately fit Cumulative arrival and service data distribution trend lines values were formulated and required queue values along a continuum within these discrete values were estimated and estimate Expected waiting time in the queue of kth customer arrive at any time x in case Queuing systems consist of one stations with no customer classes.

Keywords: queuing theory, waiting time, FCFS, queue lines, cumulative approach modeling technique.

GJRE-G Classification: *FOR Code: 290502p*

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Strictly as per the compliance and regulations of:

Predicting Waiting Time under Deferent FCFS Queue Schemes

Ibrahim Bedane

Abstract- This paper model the phenomenon of waiting in lines and predict Expected queue length, and waiting time in queue of kth customer arrive at any time x based on Cumulative Approach Analytical Technique (CAAT) to inform customers on the system state at the time of estimation. Using Modeling Technique developed and cumulative Arrival and service data collected up to time x, functions approximately fit Cumulative arrival and service data distribution trend lines values were formulated and required queue values along a continuum within these discrete values were estimated and estimate Expected waiting time in the queue of kth customer arrive at any time x in case Queuing systems consist of one stations with no customer classes, FIFO service protocols, unlimited sizes of waiting room, two number of Identical or independent servers and two types of Identical or independent service are studied. Finally, the author concludes that, based on Cumulative Arrival and service data distribution trend lines curve fitting equations and A Cumulative Approach Modeling Technique (CAMT), we can easily predict Expected queue length, and waiting time in FCFS queuing system queue line of jth customer arrive at the time of estimation. Moreover, the application of this model is feasible to drive equations and analyze phenomenon of waiting in lines; and also, this model offers better queuing systems analysis result which can be used to simulate a queuing system's performance and allows the determination of Customer appointments and effective arrival pattern management, and hence, service quality improvement. trend lines curve fitting equations of.

Keywords: queuing theory, waiting time, FCFS, queue lines, cumulative approach modeling technique.

I. Introduction

Today, businesses compete not only on quality of products but on service level as well. Recently, the time waiting for service is acknowledged as one of the most critical attributes of service level. . M. K. Hui and D. K. Tse , K. Katz, B. Larson, and R. Larson and other research point out that Customer surveys in service systems demonstrate that waiting time is a key factor when evaluating quality of service (Nakibly, 2002). In fact, waiting time is one of the main considerations when determining staffing levels (Davis., (1991) and more). A common method is to plan for the least number of agents that suffice to satisfy a required service level based on analytical modelling or simulation result. However, Very often, the service process involves delays. Waiting for some services takes place while the customer is waiting on- a face- to-face service line (laboratory diagnosis or a telephone service) or when customers continue their regular activities (waiting for an e-mail or laboratory diagnosis result reply). often, Different factors contribute to the waiting experience result in feelings of anger and in a low customer satisfaction: waiting conditions; the interest level while waiting (filled time vs. empty time); the feeling of justice (or of injustice) in the service discipline and the amount of time that a nation's populace wastes by waiting in queues, which is a major factor in both the quality of life there and the efficiency of the nation's economy. Thus, Proper queuing system's modeling and performance analysis is important components of Customers waiting time reduction and quality improvement.

Over the last decades, customers and customer satisfaction have become the major concern of almost all companies. Surveys demonstrate that customer satisfaction can be improved without changing the waiting time itself, but by managing customer expectations or by improving the waiting experience (Maister, 1985). In addition to the waiting duration itself, customer satisfaction is also affected by the perceived waiting time and by the waiting experience that may be improved by providing information or other services while waiting; making sure the physical waiting environment is comfortable (in face-to-face service); explaining the reasons for waiting; and providing information regarding the anticipated waiting time(Taylor., 1994). However, we have become accustomed to considerable amounts of waiting in service and manufacturing systems, but still get annoyed by unusually long Waiting in a crowd queue without information regarding the anticipated waiting time, which is, Usually, not interesting and undesirable. By awaking this, this paper, like more and more scholars and companies, is focusing on queuing analysis and estimations of waiting times.

Information about anticipated waiting times has important role in service systems and also objectively improves the service level; particularly, it has an important role in service systems with invisible queues (Whitt., 1999). Cleveland and Maybe describe the difference in the waiting experience between visible and invisible queues; they suggest that when the queue is visible, customers experience dissatisfaction upon arrival, as they see that there is a queue; then, as they are advancing in queue, in a satisfactory rate, the

Author: Madda Walabu University Mechanical and Industrial Engineering Department. e-mail: ibrahimbedhane@gmail.com

feelings of dissatisfaction decrease until they receive service and happily leave the system. Where as in queues that are invisible, customers do not experience dissatisfaction upon arrival, but as they are kept on hold, feelings of anger and dissatisfaction emerge; these feelings intensify until they eventually possibly abandon.

Providing waiting information in these cases may eliminate the gap between reality and customer expectations (Cleveland & Mayben, 1999). The For any of queuing systems and FCFS in particular, waiting times estimation method should be either based on the system state at a given moment which are usually tracked in real-time and needed on-line system state or system state distribution (steady state) used to predict the general behavior of the system and is performed off-line, usually, for purposes of planning and for evaluating the performance of a service system, as opposed to the experience of a specific customer. Since individual customers are usually interested on information at a given moment, the goal of this paper is to provide information which is relevant to a specific customer at a specific time. Thus, this work focuses on estimating the waiting time given the system state at the time of estimation rather than estimating the overall performance of the system, such as the average waiting time of all customers, which is usually done assuming a steady-state.

This paper aims to model and predict Expected waiting time in queue and analyze their implications on queue crowd management. In this work, estimations of waiting times is done for the purpose of informing individuals about their anticipated delays, therefore focus on estimating times given the system state at the time of estimation (arrival or any point of time during the waiting).,. The calculations involved in this method, are usually easier, but operational effort is high and the accuracy of the estimation varies accordingly. For example, when service discipline is FCFS, if we could infer the exact service requirement of each customer upon arrival, we would have been able to anticipate the accurate delay (the system would have become deterministic). Since we are dealing with stochastic systems, there is no possible way to predict the exact waiting time. The best one can do is estimate the waiting time distribution. Using model this paper ***predicts mean*** Expected queue length, and waiting time in queue of kth customer based on the system state at the time of estimation and pre inform customers. Hence estimations of waiting times depend on the information provided, system states, usually, the inputs[1] of a queueing model and characteristics of the system[2] under study, should first be defined. Motivated by the complexity of exact calculations, The goal of this work is to propose methods for estimating waiting times in FCFS queuing systems in general based on trend lines curve fitting equations derived from Cumulative Arrival and service data distribution.

Thus, this paper, First, focus on queueing system and develop basic model based on the arrival and service pattern of the First-Come-First-Served service discipline and the variables used to determine the characteristics of queuing system and propose general model that estimate Expected waiting time of kth customer arrive at any time x in different FCFS system characteristics queue line. Then, apply model and estimate waiting times for classic queueing models, that maintain a simple First-Come-First-Served service discipline and demonstrates the use of different estimation methods and demonstrates the use of estimation methods for FCFS systems with Identical servers and service types, independent servers and Identical service types, Identical servers and multiple service types, and independent servers and multiple service types. Finally, concludes based on result. Thus, this paper model Customers arrival and service distribution, write equations that describe queue pattern change over time and attempts to provide substantial answers to the following questions. How long kth customer arrive at any time x wait to be served? How many customers wait in queue crowd to be served at kth customer arrival time x?

II. Development Of The Model

This work focus on estimating times given the system state at the arrival or any point of time during the waiting time of estimation and study estimations of waiting times for the purpose of informing individuals about their anticipated delays based on trend lines curve fitting equations derived from Cumulative Arrival and service data distribution. To develop a mathematical model in the form that describes the queuing systems, requires some background study on Arrival pattern and distribution, service nature and distribution, service mix, arrival and service volume. The entry of Customers into the system (Customers arrival) and the release of a Customer upon completion (Customers departure/exit) are considered as two main events that cause an instantaneous change in the state of the system. Hence, the types and number of servers, the service order and discipline, and the distribution of service times are variables used to determine the mean server service rate and total number of customers served up to time x, this paper predict Expected queue length and waiting time in queue of jth customer arrived at time x, using a Cumulative Approach phenomenon of waiting in lines modeling and Analytical Technique.

[1] Usually, the inputs of a queuing model are the distribution of an arrival process

[2] The characteristics of the system include the number of servers, the service order and discipline, and the distribution of service times.

Thus, using Cumulative Approach Modeling Technique estimations of waiting times for the purpose of informing individuals about their anticipated delays and basic measures of performance are modeled as follows, assuming exponential service time distributions. Let:

- Na(x) denote total number of customers arrived up to time x
- Ns(x) denote total number of customers served up to time x where time x is server working time
- Nq(x)The expected number of customers waiting in the queue at any arrival time x of kth customer
- Wt.(x)=Expected waiting time in the queue of kth customer arrive at any time x
- Aj(x) denote total number of type j customers arrived up to time x and j (1, 2, …. n)
- T- Expected time to service of kth customer arrive at any time x
- S- number of servers and n- number of service type
- μe(x)- mean effective service rate at time x and μ(x)I- mean server I service rate.

Assuming infinite queue, an arriving customer is immediately entering service if there is an available agent and joins the queue if all agents are busy. Since it is first-in-first-out (FIFO) service protocol, the expected number of customers waiting in the queue at any time x is equal to the expected total number of customers arrived up to time x minus the expected total number of customers served up to time x and Expected waiting time in the queue of the customer arrived at any time x is the difference between the Expected time to service T and arrival time, x, where Expected time to service, T, of the customer can be derived from NA(x) =NS(T).

Since the characteristics of the system include the number of servers, service types and the distribution of service times are different for different FCFS systems, estimation methods for S- number of servers and n- number of service type can be denoted by mean effective service rate assuming exponential service time distributions.

where tj is service time of service type j at server i. i (1,2, …, c) and j (1,2, …, n), mean effective service rate can be:

$$\mu\mathrm{e}(\mathrm{x}) = \sum_{i-1}^{s} \mu(\mathrm{x})i;\ but\ \mu(\mathrm{x})i = [\frac{NA(x)}{\sum_{j=1}^{n} A(x)j * tj}]i$$

$$\mu\boldsymbol{e}(\boldsymbol{x}) = \sum_{i-1}^{s}\left[\frac{\boldsymbol{NA}(\boldsymbol{x})}{\sum_{j=1}^{n}\boldsymbol{A}(\boldsymbol{x})\boldsymbol{j} * \boldsymbol{tj}}\right]\boldsymbol{i} \ldots\ldots \quad \textit{Equation 1 a}$$

Thus, total number of customers served up to time x, Ns(x) is area under μeve (x) curve

$$\boldsymbol{Ns}(\boldsymbol{x}) = \int_{0}^{x} \boldsymbol{e}(\boldsymbol{x}) \ldots\ldots \quad \textit{Equation 1b}$$

$$\boldsymbol{Ns}(\boldsymbol{x}) = \int_{0}^{x}\sum_{i-1}^{s}\left[\frac{\boldsymbol{NA}(\boldsymbol{x})}{\sum_{j=1}^{n}\boldsymbol{A}(\boldsymbol{x})\boldsymbol{j} * \boldsymbol{tj}}\right]\boldsymbol{i} \ldots\ldots \quad \textit{Equation 1}$$

Note that: where mean effective service rate at time x is constant or μe(x)= μe, total number of customers served up to time x, NS(x)= $\mu e * x$,.

similarly, based on service types and the distribution of service times, total number of customers arrived up to time x of n- number of service type can be denoted by:

$$\mathrm{Na(x)} = \sum_{j=1}^{n} Aj(x), \ldots\ldots \quad \textit{Equation 2}$$

Thus: expected number of customers waiting in the queue at any time x Nq(x) = Na(x) - Ns(x) is:

$$Nq(x) = \sum_{j=1}^{n} Aj(x) - \int_{0}^{x}\sum_{i-1}^{s}\left[\frac{\boldsymbol{NA}(\boldsymbol{x})}{\sum_{j=1}^{n}\boldsymbol{A}(\boldsymbol{x})\boldsymbol{j} * \boldsymbol{tj}}\right]\boldsymbol{i} \quad \textit{Equation 3}$$

Expected time to service and are:

$$\mathrm{T} = \frac{\sum_{j=1}^{n} Aj(x),}{\sum_{i-1}^{s}\left(\sum_{j=1}^{n}\mu\mathrm{j}\right)i}, \ldots\ldots \quad \textit{Equation 4}$$

Expected waiting time in the queue of kth customer arrive at any time x of queuing system under study

$$\mathrm{Wt.(x)} = \frac{\sum_{j=1}^{n} Aj(x),}{\sum_{i-1}^{s}\left(\sum_{j=1}^{n}\mu\mathrm{j}\right)i} - \mathrm{x} \ldots\ldots \quad \textit{Equation 5}$$

by Using Cumulative Approach Analytical Technique (CAAT) and,

As illustration, assuming exponential service time distributions, this paper drive difference equations and predict expected waiting time in the queue of kth customer arrive at any time x based on formulated trend lines equations for: the number of servers, service types and the distribution of service times are different for different FCFS systems, model developed to estimate waiting times in classic queuing systems.

Furthermore, based on Cumulative Approach Modeling Technique, using Microsoft excel scatter diagram curve fitting technique, equations estimating required points between the discrete values for every single curve that represents the general trend of the cumulative arrival values along a continuum and served up to time x are determined; and hence, estimations of waiting times for the purpose of informing individuals about their anticipated delays and basic measures of performance are determined and illustrated as follows, assuming exponential service time distributions.

III. Application Of The Model

This section, apply Cumulative Approach phenomenon of waiting in lines modeling and Analytical Technique and predict Expected queue length and waiting time in queue of jth customer arrived at time x and demonstrates the use of estimation methods for FCFS systems with Identical servers and service types, independent servers and Identical service types, Identical servers and multiple service types, and independent servers and multiple service types. As illustration, the characteristics of the Queuing system consist of one station with no customer classes, FIFO service protocols, two servers and two service types with unlimited sizes of waiting room were used to demonstrate the use of different estimation methods using customers' arrival Data collected within one-hour time Intervals shown in table below

Table 1: Arrival data

Arrival Data Collected			
Intervals	A1	A2	A
Before 8:00	9	3	12
8:00-9:00	34	28	74
9:00-10:00	18	27	119
10:00-11:00	13	16	148
11:00-12:00	4	8	160

Based on data shown in table, total number of Customers arrived up to time x and cumulative number of arrival data trend lines below were derived, Where $0 \leq x \leq 4$, Na(x) is Total number of Customers arrived up to time x, A1(x) and A2(x) are Total number of service type 1 and type 2 Customers arrived up to time x, respectively. Using formulated Trend lines equations representing Arrival data and equations with 0.999 R-squared (R2) value or Square of the correlation coefficient shown in Table and figure below basic measures of performance under three cases can be determined as follow in order.

Table 2: Customers arrived up to time x

Arrival Time		Customers arrived up to time x		
Intervals	x	A1(x)	A2(x)	NA(x)
Before 8:00	0	9	3	12
8:00-9:00	1	43	31	74
9:00-10:00	2	61	58	119
10:00-11:00	3	74	74	148
11:00-12:00	4	78	82	160

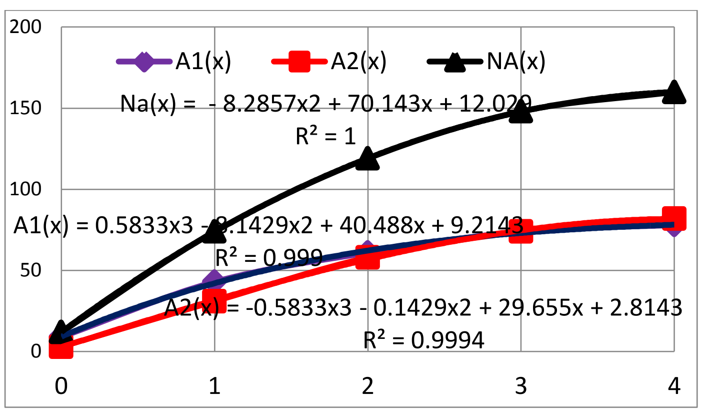


Figure 1: Arrival data trend lines and curve fitting equations

Case I: two identical servers with μ server service rates

The characteristics of the system include two number of identical servers with mean service rate of 23 customers per hour and assuming identical service types with identical distribution of service times,

a. *Arrival:* Since service types service time distribution is identical arrival pattern is over all arrival to system which is Total number of Customers arrived up to time x.

$$Na(x) = -8.2857x^2 + 70.143x + 12.029$$

b. *Service:* Since the system characterized with two number of identical servers and 23 customers per hour mean server service rate, which is, μ= 23 and S=2. mean effective service rate is μ*S

$$Ns(x)=46x; \text{ Where, } \mu*S= \mu eve = 46$$

c. *Expected waiting time in the queue of kth customer arrive at any time x*

$$Wt(x) = \frac{Na(x)}{\mu ef} - x. \;\; thus;\; Wt(x) = -0.18x^2 + 0.525x + 0.2615$$

d. *The expected number of customers waiting in the queue at any arrival time x of kth customer*

$$\mathbf{Nq(x)} = \mu ef * Wt(x).\,thus;$$
$$\mathbf{Nq(x)} = -8.2857x^2 + 24.15x + 12.029$$

Case II: Two independent servers with μ1 and μ2 service rates

The characteristics of the Queuing system consist of one station with no customer classes, FIFO service protocols, two number of independent servers with mean server service rate of 23 and 22 customers per hour, respectively and unlimited sizes of waiting room are modeled

a. *Arrival:* Since service types service time distribution is identical arrival pattern is over all arrival to system which is Total number of Customers arrived up to time x.

$$\mathbf{Na(x) = -8.2857x^2 + 70.143x + 12.029}$$

b. *Service:* Since the system characterized with two number of independent servers with mean server service rate of 23 and 22 customers per hour, which is, μ1= 23, μ2= 22 and S=2. mean effective service rate is μeve is:

$$\mu eve = \sum_{i-1}^{s} \mu i = 23 + 22 = 45.\ \text{Thus, } Ns(x)=45x$$

c. *Expected waiting time in the queue of kth customer arrive at any time x*

$$\mathbf{Wt(x)} = \frac{Na(x)}{\mu ef} - x.\ \ thus;\ Wt(x) = -0.184x^2 + 0.5587x + 0.2673$$

d. *The expected number of customers waiting in the queue at any arrival time x of kth customer*

$$\mathbf{Nq(x)} = \mu ef * Wt(x).\,thus;\ Nq(x) = -8.2857x^2 + 25.143x + 12.029.$$

Case III: Two Identical servers and Two service types

The characteristics of the Queuing system consist of one stations with no customer classes, FIFO service protocols, two number of identical servers, two service type with mean service time of 2.5 and 2.857 minute per customer, and unlimited sizes of waiting room

a. *Arrival:* Since service types service time distribution is not identical arrival pattern is each service types arrival to system which are Total number of service type I and II Customers arrived up to time x.

$$\mathbf{A1(x) = 0.5833x3 - 8.1429x2 + 40.488x + 9.2143}$$
$$\mathbf{A2(x) = -0.5833x3 - 0.1429x2 + 29.655x + 2.8143}$$
$$\mathbf{Na(x) = -8.2857x^2 + 70.143x + 12.029}$$

b. *Service:* Since the system characterized with two number of identical servers and two service type with mean service time of 2.5 and 2.857 minute per customer, mean server service rate, is 1/mean service time

mean SERVER service rate μ is: μ(x)

$$\mu(x) = \frac{Na(x)}{A1(x) * T1 + A2(x) * T2}$$

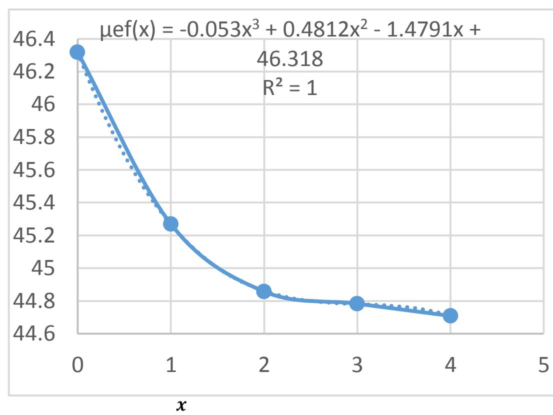
where T1=2.5 (0.0417 hr./cuts.) and T2=2.857 (0.047617 hr./customer). Thus;

$$\mu(x) = -0.0265x3 + 0.2406x2 - 0.7396x + 23.159$$

thus, mean effective service rate is μeve is: **μeve(x)** = μ(x)

$$*S= 2(-0.0265x3 + 0.2406x2 - 0.7396x + 23.159)$$
$$\mu eve\ (x) = -0.053x3 + 0.4812x2 - 1.4792x + 46.318$$

since area under *μeve (x) curve is* **Ns(x)**



$$Ns(x) = \int_0 -0.053x3 + 0.4812x2 - 1.4792x + 46.318$$

$$\text{Thus, } Ns(x) = -0.01325x4 + 0.1604x3 - 0.7396x2 + 46.318x$$

c. *The expected number of customers waiting in the queue at any arrival time x of kth customer*

$$\mathbf{Nq(x) = Na(x) - Ns(x)}$$
$$\mathbf{Nq(x)} = 0.01325x4 - 0.1604x3 - 7.5461x2 + 23.825x + 12.029$$

d. *The expected number of customers waiting in the queue at any arrival time x of kth customer*

$$\mathbf{Wt(x)} = \frac{Nq(x)}{\mu ef}.$$

$$Wt(x) = \frac{0.01325x4 - 0.1604x3 - 7.5461x2 + 23.825x + 12.029}{-0.053x3 + 0.4812x2 - 1.4792x + 46.318}$$

$$thus;\ W(x)III = -0.0017x^3 - 0.1724x^2 + 0.5377x + 0.2594 = 0.0008x4 - 0.0077x3 - 0.1576x2 + 0.5269x + 0.2597$$

In general, The basic idea is to fit a curve or a series of curves that pass directly through each points of discrete Total number of customers arrived and/or served up to any time x Data. Using Microsoft excel sheet, a function that approximately fit parameters of system of interest with more than 0.997 Square of the correlation coefficient and The rate of change in these values with respect to time x can be denoted by fitting a curve along the discrete data points. Thus, based on discrete Data along a continuum on Total number of customers arrived and/or served up to any time x, Estimation of required points between these discrete values is possible for every single curve that represents the general trend of the data from trend lines equations derived. Using these basic setup, this paper makes it possible to model a function that approximately fit parameters of system of interest, estimate Expected waiting time in queue of kth customer arrive at any time x and simulate the performance of a system on which analytical result of interest can be easily computed.

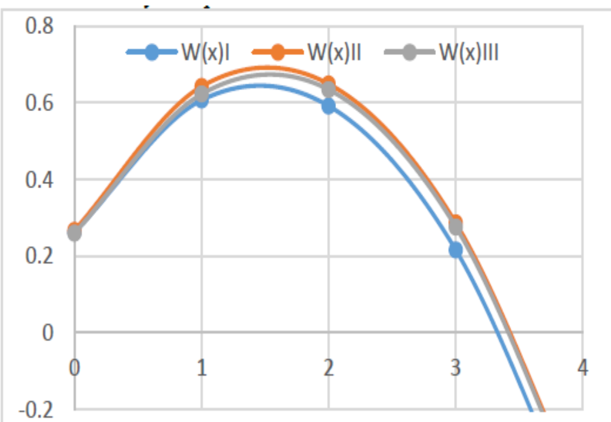


Figure 2: Expected waiting time in the queue of kth customer arrive at any time x

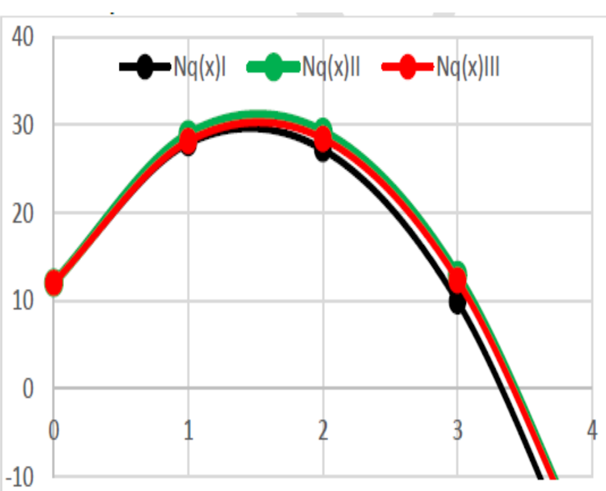


Figure 3: The expected number of customers waiting in the queue at any arrival time x of kth customer

In general, based on developed Modeling Technique, this paper shows how this model can be used to predicts mean Expected queue length, and waiting time in queue of kth customer based on the system state at the time of estimation and manage crowd in queue by integrating the movement of the Service into the actual operation of the resource performing the work.

As shown in application, This model suit to drive difference equations for The characteristics of the Queuing system consist of one stations with no customer classes, FIFO service protocols given with Identical servers and service types, S number of independent servers and Identical service types, S number of Identical servers and multiple service types, and S number of independent servers and multiple service types and predict expected kth customer waiting time in FCFS case queue systems at the time of estimation. The findings show that, using Cumulative arrival and service parameters up to stationary time that has been in operation, the expected queue length and waiting time in queue of kth customer estimation methods for different characteristics of the FCFS system with S- number of servers, n- number of service type and different distribution of service times at the time of estimation can be denoted. Thus, where, estimation methods of expected waiting time in the queue of kth customer arrives at any time x, Wt(x) and the expected number of customers waiting in the queue at any arrival time x of kth customer, (x); The General estimation methods for the system characterized with s number of servers and n service types under different schemes can be denoted as shown below. For:

a. *The system characterized with s number of identical servers is:*

$$\mathrm{Wt(x)} = \frac{Na(x)}{\mu * S} - x$$
$$\mathrm{Nq(x)} = \mu * S * Wt(x)$$

b. *The system characterized with s number of independent servers is:*

$$\mathrm{Nq(x)} = \sum_{i-1}^{s} \mu\boldsymbol{i} * Wt(x)$$
$$\mathrm{Wt(x)} = \frac{Na(x)}{\sum_{i-1}^{s} \mu\boldsymbol{i}} - x$$

c. *The system characterized with s number of identical servers and n service types is:*

$$\mathrm{Nq(x)} = \sum_{i-1}^{s} \mu\boldsymbol{i(x)} * Wt(x)$$
$$\mathrm{Wt(x)} = \frac{Na(x)}{\sum_{i-1}^{s} \mu\boldsymbol{i}\,\boldsymbol{(x)}} - x$$

$$where, \mu i(x) = \frac{\boldsymbol{Na(x)}}{\sum_{j=1}^{n} \boldsymbol{Aj(x) * Tj}}$$

d. *S no. of Independent servers and n service types*

$$Wt.(x) = \frac{\sum_{j=1}^{n} Aj(x),}{\sum_{i-1}^{s}(\sum_{j=1}^{n} \mu j)i} - x$$

$$Nq(x) = \sum_{i-1}^{s}\left(\sum_{j=1}^{n} \mu j\right) i * \mathrm{Wt(x)}$$

IV. Result and Discussion

Using ***Cumulative Approach Modeling Technique developed,*** this paper ***make it*** possible to write equations that describe how the number of customers in each queue in the system of interest changes over time for a First-Come-First-Served service discipline and facilities, which experience time-varying customer arrival patterns and ***predicts mean*** Expected queue length, and waiting time in queue for the purpose of informing individuals about their anticipated delays based on estimating times given the system state at the time of estimation. Thus, based on Information about anticipated waiting time, organization can shorten the perceived waiting time reduces the uncertainty and increases customer satisfaction.

Moreover, This Analytical technique show every fluctuation and pattern of queue characteristics of the system changes over time and forecast the pattern of waiting time. It shows how time customers arrive determines the time customers wait in queue lines and analysis the relationship between Customer arrival time and average times the customer spent in the queue. The result has also revealed correlation between Customers' waiting times and the number of Customers waiting; a positive for Customers arrives before number in queue reach its maximum and negative for Customers arrives after as shown in figure xx above. In this instance, for each unit of time that the server is available, the average time in queue increases as number of Customers in the queues increases and decrease as number of Customers in the queues decreases with the same rate. Briefly, when total number of Customers arrived per unit time is greater than total number of Customers served per unit time queues continue to grow over time. When total number of Customers arrived up to time t is greater than total number of Customers served up to time t and total number of Customers served per unit time interval t is greater than arrived, queues continue to decelerate over time interval. When Total numbers of Customers arrived and served are equal, expected number of customers in queue and time in queue of the customer arrives after time t is zero. In addition, when total number of Customers arrived up to time is less than total number of Customers served up to time, crowd in queue is zero continuously over time. The customer arrives at time t when number of Customers in the queue is Maximum, expect maximum waiting time in queue and expected waiting time in queue is zero for the customer arrives exactly after time t at which number of Customers in the queue is zero. Based on waiting information provided, manager can recommend the best moment at which customer arrives and get service without waiting for long time in queue line.

Furthermore, result showed that, this model suit to obtain closed-form or recursive formulae that measures performance of queuing systems over change of time which, allow system designers to calculate performance metrics that describes the phenomenon of waiting in lines such as average queue length, average waiting time, and the proportion of customers turned away. this paper looks at arrival and service distribution and pattern change over time write equations that calculate operational attributes of the service level: service times, waiting times, number of people in the system, percentage of abandoning customers and more and describe queue and queue crowd changes over time. developed analytical technique queueing models can be used to obtain the analytical result of performance of system such as: the time Customers in queue service time and time at which no Customers in queue.

As shown in figures, hence servers are capable of serving all arriving Customers, queue occurrence not due to server capacity, Queues form when customers arrive at a service facility at time they cannot be served immediately upon arrival. Thus, increasing number of server further increase time at which no Customers in queue, which means server idleness increased. By specifying reasonable limits on conflicting measures of performance such as average time in the queue and idleness percentage of the servers, anyone can determine an acceptable range of the service level through effective arrival management system. To manage arrival pattern, the arrival rate should be decreased during busy times and increased during "slow" periods by providing Different types of waiting information to customers. The decision of what quantile of the waiting time distribution queue-size, waiting time of the longest-waiting customers or the anticipated waiting time of an individual customer to inform, depends on the desired outcome. The service system manager should then decide what is the exact information that will be provided to customers. informing individuals about their anticipated delays based on estimating times given the system state at the time of estimation right upon arrival, Customers can decide if or whether they are willing to wait. As less customers decide to abandon after already waiting for a while, the steady-state number of customers in queue decreases and so does the percentage of customers who find the system full.

V. Conclusion

This paper developed Cumulative Approach phenomenon of waiting in line Modeling Technique and predict mean expected queue length and waiting time in queue of kth customer of a First-Come-First-Served service discipline queueing systems at time for the purpose of informing individuals about their anticipated delays based on estimating times given the system state at the time of estimation. Cumulative Approach Analytical Technique (CAAT) is feasible to model the phenomenon of waiting in lines using representative measures of performance and predict mean expected queue length and waiting time in queue of kth customer arrive at any working time x. Using this model, analytical result of the performance of a system with time-decisive parameters that has been in operation for a sufficiently long time such that time t no longer affects the distributions of number in system, number in different queues, waiting times, and total delay are possible. the Cumulative Approach Modeling Technique is useful to simulate a queuing system's performance, shows how time customers arrive determines the time customers wait in queue lines crowd and analysis the relationship between Customer arrival time and average times the customer spent in the queues and queue crowd. On the other hand, it helps us to identify source of queue crowd at any time and easily specify reasonable limits on conflicting measures of performance such as average time in the queue and idleness percentage of the servers and indicate how and time at which improvement in system change the queue performance indicators and at what time the queue performance indicators changed very little. Moreover, this model is flexible. While simple linear models were used in this application, no difficulty is foreseen in adapting the model for nonlinearities in either Customer demands or service costs. In addition, the inherent flexibility of the model would permit it to adapt easily to sub models of Customer admission rates in the various medical categories. Finally, the author concludes that, the application of Cumulative Approach Modeling Technique can easily predict mean expected queue length and waiting time in queue of kth customer arrive at any working time x and offer better queue performance analysis result.

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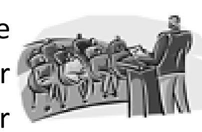

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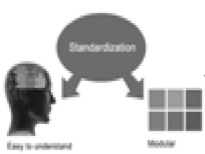

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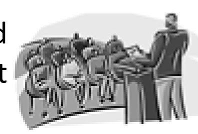

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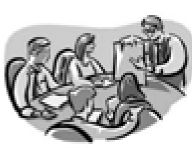

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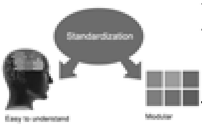

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4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

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Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

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Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

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It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

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Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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Abstract, used in Original Papers and Reviews:

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Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

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15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

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32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

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Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

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- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

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Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

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This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

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- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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