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EDITORIAL

Greetings from IAARHIES and the Conference organizing Committee!

At the very outset, we extend a warm welcome to all our distinguished guests, speakers and the participants who have joined us for this International Conference in Kuala Lumpur, Malaysia.

We are happy to receive the research papers from all part of the world and some of the best papers published in this proceedings. The current edition of the proceedings brings out the various research papers from diverse area of Engineering, technology, and Humanities. The IAARHIES conferences are an attempt to provide a platform to the researchers, educators and professionals to present their innovative thoughts and discoveries and to explore future trends and applications in the field of Engineering and Technology. However, this conference will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above said area with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. Our final goal is to make the Conference proceedings useful and guiding factor to audiences involved in research in these areas, as well as to those involved in design, implementation and operation, to achieve their respective goals.

We once again are thankful to all the delegates participating in this event in Kuala Lumpur, Malaysia. We are sure about the contributions to be added by the participating authors to the research community and rapidly growing field of education throughout the globe. We are also thankful to all the International advisory members and reviewers for making this event a successful one.

"Let your mind start a journey through a strange new world,
Leave all thoughts of the world you knew before,
Let your soul take you where you long to be,
Close your eyes, let your spirit start to soar and you'll live as
you've never lived before."

-Erich Fromm

Sandeep Kumar   **Dr. Hardev Sharma**
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CONTENTS

TEMPERATURE SEPARATION IN A VORTEX TUBE – AN OVERVIEW

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ABSTRACT - A vortex tube, is a simple mechanical device capable of generating separated cold and hot fluid streams from a single injection, has been used in many applications, such as heating, cooling, and mixture separation. To explain its working principle, both experimental and numerical investigations have been undertaken and several explanations for the temperature separation have been proposed. However, due to the complexity of the physical process in the vortex tube, these explanations do not agree with each other well and there has not been a consensus. The purpose of this paper is to present review of current explanations on the working concept of a vortex tube. Hypotheses of pressure, viscosity, turbulence, temperature, multi circulation are discussed in the paper.

Keywords: Vortex tube, temperature separation, tangential velocity

1. INTRODUCTION

The phenomenon of temperature separation in a swirling vortex flow was discovered in 1930s by Georges J. Ranque. Ranque proposed that compression and expansion effects are the main reasons for the temperature separation in the tube [1,2]. Later, the geometrical parameters and performance optimisation of the tube were investigated by Hilsch [3]. He added the effect of inner friction to the Ranque's model of compression and expansion.

The vortex tube is referred to as the Ranque vortex tube (RVT), Hilsch vortex tube (HVT), Maxwell–Demon vortex tube (MDVT) and Ranque–Hilsch vortex tube (RHVT). The RHVT consists of a circular tube with an inlet orifice, where compressed gas flows tangentially through several nozzles, azimuthally arranged. The high pressure flow affected from very strong swirling motion is split into two streams of different temperatures: the hotter one spiralling in touch with the wall in the outer zone of the tube, the colder one spiralling in the opposite direction close around the central axis (Fig. 1)

The hot and cold gas streams leave the device through two axial outlet orifices that can be arranged either both on the same side of the tube (uni-flow vortex tube) or on the opposite sides of the tube (counter-flow vortex tube). When compressed air is injected into the tube from the tangential inlet, it forms a highly vertical flow and moves to the other end of the tube. The peripheral part of the airflow escapes from the hot exit at a higher temperature than the inlet temperature and the core part of the airflow,

which is forced back by the plug in a counter-flow vortex tube, escapes from the cold nozzle at a lower temperature than the temperature of fed air. The mass flow rate is regulated by a cone-shaped control valve, placed near the hot exit. This valve can vary the mass flow rate leaving the hot exit influencing the temperature of the gas leaving the device.

The vortex tube is today used in several industrial applications like separating gas mixtures, liquefying gases, purifying and dehydrating two-phase mixtures, cooling tools in operation, cooling cabinets of electronic devices, separating particle in gas streams, etc. It is well suited for these applications because it allows an accurate temperature control, it is light, it does not require any maintenance, it is easy to use and it can work with different gases. Thermal separation effect is reported to work supplying RHVT with high pressure liquids too , although in this case, the cold stream never reaches as a low temperature as the one of the inlet stream because of the important role played by fluid compressibility in the cooling process of the internal stream. Hundreds of papers have been published about the temperature separation in the vortex tube, with the greatest contribution being to the understanding of the Ranque–Hilsch vortex tube.
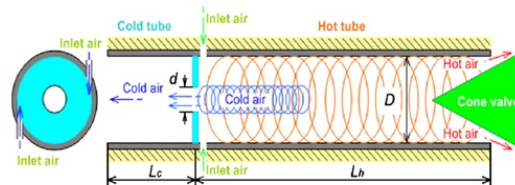

Figure 1: schematic diagram of the vortex tube (counter flow)

2. PRESSURE & TEMPERATURE DISTRIBUTION

Pressure change in the vortex tube was the first phenomenon to be investigated. Compression and expansion were discussed by Ranque [1,2].Figure 2 show the pressure distribution.

The main reasons for the temperature separation in the RHVT. It was explained that due to the structure of the vortex tube, sudden expansion occurs when the compressed air is injected into the tube and the temperature of the air flow in the core drops in the process of expansion [8–15]. In more recent research, the temperature drop near the entrance of the RHVT was investigated using a numerical simulation [16].

The blue region1 in Fig. 3 represents the lowest temperature of 280.0 K near the entrance of the RHVT when the injected air has the temperature of 300 K. Also, it was shown that the peripheral flow has a higher temperature than the core flow, which can be explained by the radial pressure distribution of the flow [17]. The temperature drop due to sudden expansion can be approximately calculated by the equation of adiabatic expansion:

$$P_1^{\gamma-1} T_1^{-\gamma} = P_2^{\gamma-1} T_2^{-\gamma} \qquad (1)$$

$$\gamma_1^{\gamma-1} T_1 = \gamma_2^{\gamma-1} T_2 \qquad (2)$$

where P, T and γ are the pressure, temperature and specific volume of the air flow, respectively, and γ = 1.4 is the specific heat ratio of the air flow. According to the experiments [18,19], when specific volume change is applied in the calculation, the temperature of cold air can be as low as 278 k (temperature drop of 287 K). When pressure is used to predict the temperature [21], the temperature of cold air is 257 k (temperature drop of 257 K). The coldest temperature measured in the experiment conducted by the authors [18,19] was 25 C (temperature drop of 25 K), which is much higher than the theoretical calculations based on adiabatic expansion. The difference between the theoretical calculation and the experimental results suggest the influence of other factors in the thermal separation in a RanqueHilch Vortex Tube, preventing the pure adiabatic expansion and intense temperature drop. Nevertheless, the temperature drop due to the sudden expansion contributes significantly to the overall temperature separation.

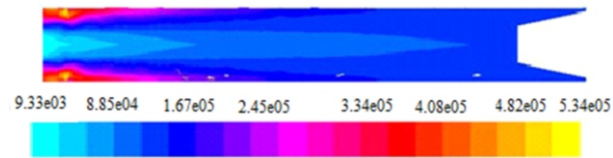Some other studies have suggested that the generation of a

Figure 2: Pressure distribution
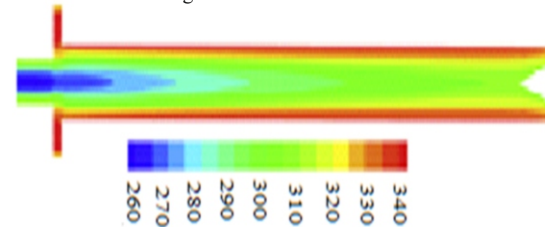
Figure 3: Temperature distribution

forced vortex is the main reason for the existence of a radial pressure gradient. Based on [12,22], the pressure gradient of forced vortex causes the temperature distribution of high temperature in periphery and low temperature in core, due to the compression in the higher pressure in peripheral region and the expansion in the lower pressure core region. The forced vortex and its effect on the velocity distribution were investigated in other works [9,17,23–25]. close to the wall [9].

Temperature distribution in the tube was provided by the expansion and compression of the compressible working material; thus the compressibility of the working material was essential to the temperature separation in a vortex tube [26]. However, theoretical and experimental investigations on strong rotating incompressible flow [27,28] showed the possibility of the temperature separation in the vortex tube without the effect of pressure variation. An experimental study conducted by Balmer [29] showed the temperature separation existed when high pressure water was used as working media in the tube. Consequently, in the case of compressible flow, theories based on the pressure gradient and its effect on the temperature drop in the core of the tube, mainly due to the sudden expansion, have been supported by many researchers [9,11,13–16,23,29], however there has not been an agreement about the reasons for the temperature increase in the peripheral flow. Some of these factors will be reviewed in the following sections. Further research is anticipated on the contribution of the sudden expansion and the influence of the compressibility of the working

material on the temperature drop.

3.   TURBULENC EEFFECT

The physical process of the air flow inside the vortex tube can be described and analyzed by using velocity distribution (fig 4), which has been investigated by many researchers. Explanations of the temperature separation in the vortex tube have been formed based on the description of the flow structure. Viscosity and turbulence involved in these hypotheses were considered as the reasons for the temperature separation. The highest amount of turbulent refers to inlet section. Figure 4 shows turbulent kinetic energy in a vortex tube.
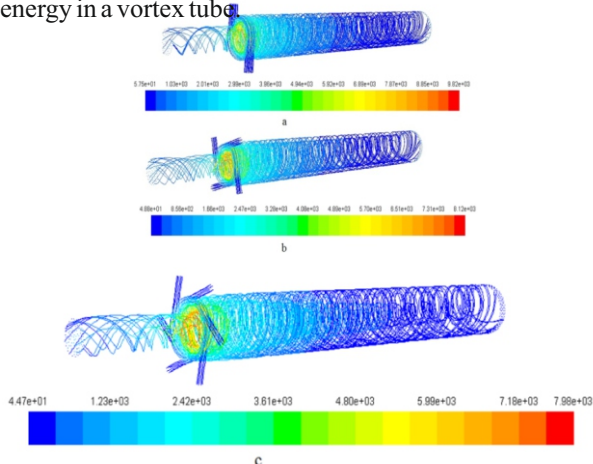
Figure 4: Turbulent Kinetic Energy, a- Vortex Tube With 2 Nozzle , b- Vortex Tube With 4 Nozzle c- Vortex Tube With 6 Nozzle[30]

The physical process of the air flow inside the vortex tube can be described and analyzed by using velocity distribution (fig 4), which has been investigated by many researchers. Explanations of the temperature separation in the vortex tube have been formed based on the description of the flow structure. Viscosity and turbulence involved in these hypotheses were considered as the reasons for the temperature separation. The highest amount of turbulent refers to inlet section. Figure 4 shows turbulent kinetic energy in a vortex tube.

This figure shows the highest turbulent kinetic energy is near the inlet area and with increase number of nozzle turbulent kinetic energy to be reduce and temperature separation by vortex tube increased but addition number of nozzle without any effect on zone of turbulent kinetic energy.

An investigation conducted by Fulton [31] showed that the tangential velocity of the peripheral layer was lower than that of the inner layer at the entrance of the tube, meaning that a free vortex was being formed. Because of the shear stress between different layers, the slow peripheral flow was accelerated by the inner flow, while the inner flow was decelerated. In this process, kinetic energy was transferred from the inner layer to the outer layer by inner friction. Temperature rise occurred because the energy transferred to the peripheral flow, and additional energy transported by turbulence between the two layers helped the formation of temperature gradient in the vortex tube. It is indicated in a similar explanation that in the "conversion to a forced vortex", angular momentum is transferred outwards by the internal friction between inner and outer layers [15,31] and the transportation of the kinetic energy is regarded as the reason of the energy separation.

The concept of the inner friction and turbulence effect is supported by numerous experimental, theoretical and numerical studies conducted by other researchers [10,13,28,31–32]. Some of the explanations are based on the viscous friction between the working fluid and the wall of the tube [9,11,14–16].

It has been suggested that the heat generated by the friction between wall of the tube and air flow converts the kinetic energy to thermal energy, which causes the rise in temperature. Numerical simulations have been used to analyses the temperature separation phenomenon. Different turbulence models have been used to simulate the complex flow inside the vortex tube, such as standard k–ε model [25], large eddy simulation [24], and an algebraic Reynolds stress model [17]. The numerical studies based on different models have generally shown reasonable agreement with the experimental results of some researchers, but do not fit all the available experimental data obtained under similar geometric and flow conditions. Different turbulence parameters and assumptions used in numerical analyses result in different conclusions which are occasionally contradictory, such as the static temperature gradient which will be discussed later. In one of the experiments [33], a mini vortex tube with an inside diameter of 2 mm was tested with laminar flow at the inlet of the tube. The experimental results showed the performance of the tube improved as the inlet Reynolds number increased from 0 to 4000.

The vortex tube with laminar flow at the injection shows the further analysis is required to verify the effect of turbulence. More research into the geometrical parameters

of the vortex tube, which have great influence on the tube performance but have not been clarified in the turbulent models, is also required.

4. MULTI CIRCULATION

In the investigation of the counter-flow vortex tube, it was evident that the proportion of cold air forced back by the hot end plug was larger than the proportion of cold air exhausted from the cold nozzle [21,34–36]. Hence, part of the cold air that is forced back by the plug must return to the hot end, thereby forming the multi circulation (or re-circulation) as shown in Fig. 6 .

The effect of the secondary circulation on the temperature separation in a RHVT was investigated experimentally and theoretically by many researchers [5,21,23,24,25,30,,39]. It was suggested that the secondary circulation in the tube formed a classic refrigeration cycle which transferred thermal energy from the inner flow to the outer flow [34–38]. Thermal energy was absorbed by the secondary circulation along the centreline on the way back to cold end and transferred to the peripheral flow when it flowed with the primary flow to hot end. In this way, the temperature of the outer layer.
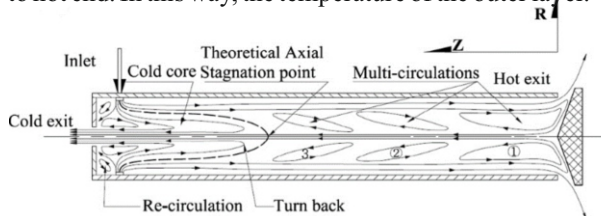

Figure 5 .multi circulation and working process in the vortex

However, the existence of the secondary flow in vortex tubes has not been supported by all researchers. A numerical investigation of the vortex tube [9] stated that the secondary flow could be formed when the size of the cold nozzle was small enough. As the diameter of the cold nozzle increases, the secondary circulation becomes weaker and completely disappears when the ratio of the cold end diameter to the tube diameter is 0.58 (i.e. dc/dt = 0.58, where dc is the diameter of cold nozzle and dt is the diameter of the vortex tube).

5. CONCLUSION

The issue concerned in all explanations is the energy transfer between different layers. The temperature separation in a RHVT can be studied considering two factors: temperature drop and temperature rise. The temperature drop in a vortex tube can be considered as the combination effects of sudden expansion near the entrance, energy transferred outward because of the internal friction and turbulence, secondary flow and static temperature gradient. The temperature rise can be considered as the result of compression at the periphery, static temperature gradient, energy transferred due to the friction between the turbulent layers, friction between air flow and wall and the secondary circulation.

In conclusion, the energy separation in the vortex tube seems to involve a number of different factors such as tangential velocity, pressure inlet, multi circulation and geometry design but In short, according to the previous review paper, the viscous friction due to the complex flow behaviour near the hot end is believed to be the main reason for temperature separation in a vortex tube.

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Use 10-point Times New Roman font for the references and list references at the end of the paper in alphabetical order according to the last name of the first-named author. Include the following information (as applicable).

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ORIGINS OF GEOMETRIC COMPUTATIONAL DESIGN
IN ARCHITECTURE

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ABSTRACT - The changes that the computer is bringing to architecture are one part of a revolutionary social upheaval. Tools not only change individual patterns and behaviour, but also cause transformations in institutions. Just as other tools have in the past, the computer is in the process of conditioning our understanding of the world and our perception of our place in it. The application of computers to architecture is more than anew sophisticated tool that can be manipulated like a pencil or pen. It is rather, "the culmination of the objectifying mentality of modernity and it is, therefore, inherently perspectival. The tyranny of computer-aided design and its graphic systems can be awesome: because its *rigorous mathematical base* is unshakable, it *rigidly* establishes a homogeneous space and is inherently unable to combine different structure of *reference*." Digital space is quantified by a programmer, who enacts a simplification of reality through a process of abstraction in which empirical that does not fit the chosen conceptual framework is discarded.

The aim of this paper is to investigate and track the origins of the core concepts of geometrics in the history of architecture and to designate its basic conceptual applications that could be probably using the same concepts and processing steps that are used today with computers. The gained benefits of this investigation could help in boosting new methodologies in architectural design regarding form generation. Comparative analysis shall be the methodology used to reach these theoretical origins, and, the royal palace of the Alhambra will be the main case study together with related styles from Islamic architecture.

Keywords: Geometry, Architectural design, Genetic algorithms, Islamic architecture.

1. INTRODUCTION

Geometry lies in the core of the architectural design process. It is omnipresent, from initial form-finding stages to actual construction. It also underlies the main communication: namely, graphical representations obtained by precise geometric rules. Whereas the variety of shapes that could be treated by traditional geometric methods has been rather limited, modern computing technologies have led to a real geometry revolution. In the genesis of the work of art, shaping principles is named "the structural theme" of the work, and sees it as working in conjunction with a cosmos form building force called the "anabolic tendency". The structure theme "must be conceived of dynamically, as a pattern of forces, not an arrangement of static shapes" (Figure-1). Modern architecture takes advantage of the greatly increasing design possibilities, and geometric computing is a broad area with many branches. An interdisciplinary field such as architecture benefits from such variety [8].
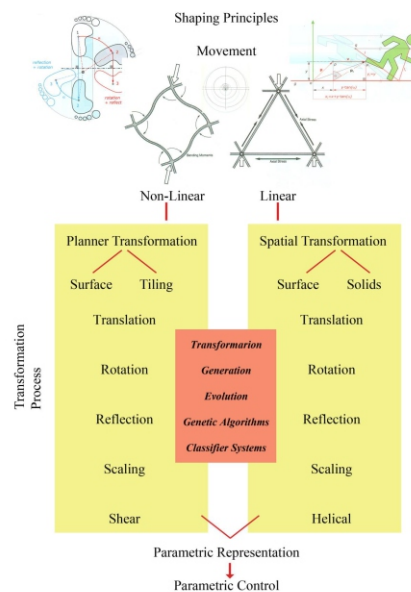

Figure 1: Development of geometry shaping process.

2. SHAPING PRINCIPLES, CELLULAR AUTOMATION AND GENETIC ALGORITHMS

Cellular automata are a special class of poly automata which lend interesting insights into how complex behaviour can emerge from simple rules. They are disarmingly simple devices for demonstrating the behaviour of rule-based systems. A cellular automaton consists of a regular array of cells in one, two, three or more dimensions. Each cell is said to have neighbours which are cells with some specified spatial relationship. In the simplest two-dimensional grid of squares, a cell might in having four edge neighbour, or eight, including these of the diagonal. In three dimensions, a cube cell might be considered to have six-face neighbours, or up to twenty-six if those adjacent to the edges and vertices are also counted. The behaviour of the cellular automation is controlled by transition rules which determine the state of each cell at each moment in time in relation to the previous state of the cell and of the whole of an automation at one instant and by the operation of transition rules which usually affect every cell in the same way, synchronously (the system responds to some form of "clock" pulse).

The rules of the individual cells are referred to as local and the overall behaviour as global. Successive changes are often referred to as "generations" and "neighbours", affecting behaviour may be referred to as "parents" and "grandparents". Complex behaviour can result from simple local rules. While the rules control the overall behaviour of the emergent "pattern", the precise nature of an actual configuration may be significantly affected by the "seed". A variety of behavioural pattern can emerge (Figure-2).

This forms the basis of a mathematical formalism which defines a set of structures appropriate to the field of interest using all possible combinations of elements (chromosomes). An environment is then defined for the system undergoing adaptation: this is an adaptive plan which determines successive structural modifications in response to the environment and measures the performance of different structures in the environment. This treatment is then developed into generalized reproductive plan and genetic operations.

The technique of genetic algorithms was developed primarily for problem-solving and optimization in situations where it was possible to state clearly both the problem and the criteria to be fulfilled for their successful solution.

Genetic algorithms are a class of highly parallel, evolutionary, adaptive search procedures. They are characterized by a string like structure equivalent to the chromosomes of nature. These represent a coded form of parameters which control the problem being investigated.

Algorithm is derived from the Persian/Arabic mathematician Al-Khwarizmi and originally referred exclusively to the arithmetic rules for manipulating Arabic numbers. Nowadays, algorithm means somehow: a definite procedure for solving problems or performing tasks. An algorithm consists of instructions how to do a task by splitting it into subtasks and sub-operations describing their order in a process. In most programming (or instructing) of computers it is necessary to be rigidly
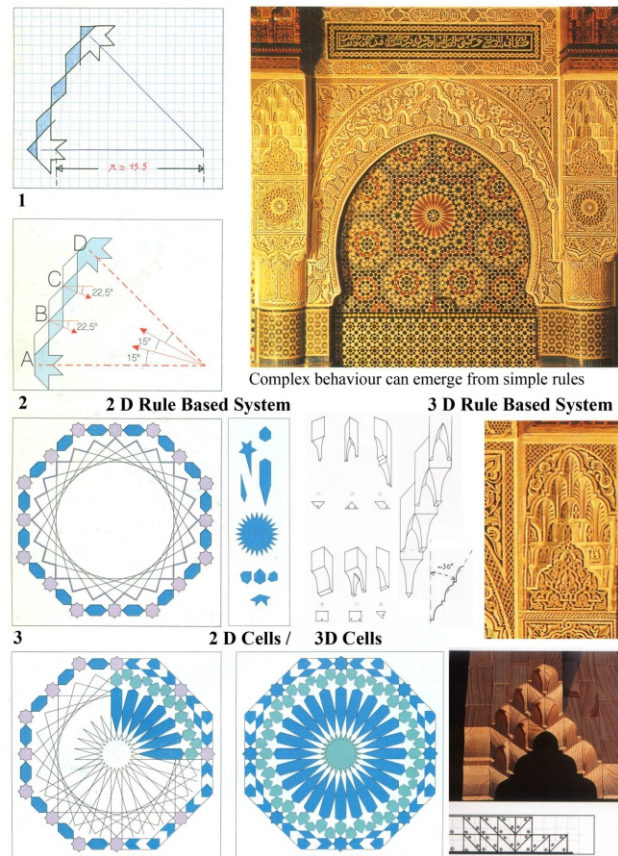

Figure 2: Behaviour of rule-based systems in traditional 2D/3D Islamic patterns.

precise and complete. Algorithms are rules and techniques (definite procedures) for writing such instructions or code. Algorithmic thinking shares with number systems and

logics the fundamental ideas of precision and determinedness. Algorithms and mathematical functions abide so to say to the "ideology" of determining a unique element or step for any input or previous step (related to the notion of abstract Turing machines.

The case of muqarnas formation is a direct application of the technique of the genetic algorithm which was developed primarily for problem-solving and optimization and a class of highly parallel, evolutionary, adaptive search procedures. They are characterized by a string-like structure equivalent to the chromosomes of nature. These represent a coded form of parameters which control the problem being investigated. They are described as highly parallel because they search using populations of potential solutions rather than searching randomly for adjusting a single potential solution.

Since optimum solutions are obtained by small, gradual changes within the population over several generations, they are defined as adaptive. Selection from the population occurs according to a measure of fitness criteria.

The behaviour of the muqarnas invented and applied widely in Islamic architecture since 9th century, applied a rule-based system that was applied manually by builders who were perfectly trained on geometrics and mathematics. They followed a clear mental model i.e. a powerful relational operations for a rigid implications of solid modelling with a set of powerful relational operators to encourage the builder to specify logical relationships between elements rather than specific geometric coordinates. This process required the syntax and grammar of a particular formal language to be specified in advance (Figure-3).

It is within the subjective space of the aesthetic experience that the things seen (the architectural forms) and the things known (the epigraphic content) truly articulate themselves, in fact giving birth to diversified semantic connections. Among these connections, imaging associations take place that govern the determination of metaphors, namely the mutation of a certain potentially virtual image into defined metaphors. Under the dual effect of visual suggestion and scriptural imagery, all those faculties related to the imaginative (the cognitive, the informative, the re-collective and so on) are excited and build various combinations, associations and correspondences, through which the material field fills with epigraphic sense and identifies its perceptible form with iconological elements [6].

It is clear from the comparative analysis in figure 3, that the iconic elements used in Islamic architecture compared to any architectural style in the history of architecture, has the ability of developments through an up to date form generation process (digital process). The pediment used in Greek architecture is used as it is after 25 centuries on a top of an office building by Philip Johnson, where nobody could recognize it [7]. The Doric column was re used as a whole building! On the contrary, traditional Islamic patterns based on in stored mathematical data were developed, regenerated and re used in a completely different function and also in a homogenies compatible sense of cognition [4]. Here we could insist that pure cognition is compromised by digital re-creation derived from stored data, which is derived externally. The Platonic dream, of a crystal clear vision of reality seen through a mental rather than physical eye, is replaced by an existential construct, a reality reconstituted from information, constrained by binary choice [9].

Now the geometric models used in traditional art have nothing to do with a rational, or even a rationalistic, system-artization of art; the derive from a geometry which is a priori non-quantitative and which is itself creative because it is linked to data inhering directly in the mind. At the basis of this geometry there lies the circle which is an image of an infinite whole [2].

At the Alhambra palace in Spain from the Nasrid period, and especially at the Comares Hall, the metaphorical language resolves in the practice of art the difficult question of how to represent the unrepresentable, and by extension, how to represent without representation. The specific type of the imaging metaphor supplies a mode of virtual representation, a means of visualising the invisible and that the Comares Hall exploits with a high degree of rhetoric [6].

3 GEOMETRICS, AESTHETICS AND THE CONCEPT OF SPACE

Returning to the Comares dome, by virtue of aesthetic relevance of the limits, the half stars at the margins of the supporting square strengthen the virtual continuity /infinity of the design beyond it, in an endless expansion which confers on the artefact the aesthetic character of a space in dilation, of an open field. Such a property makes the ceiling morphology oppose the enclosure shape Qur,anic heavenly bodies ,due to their strict numerical limitation. No transitional elements mediate the meeting between the square and circular morphologies; an

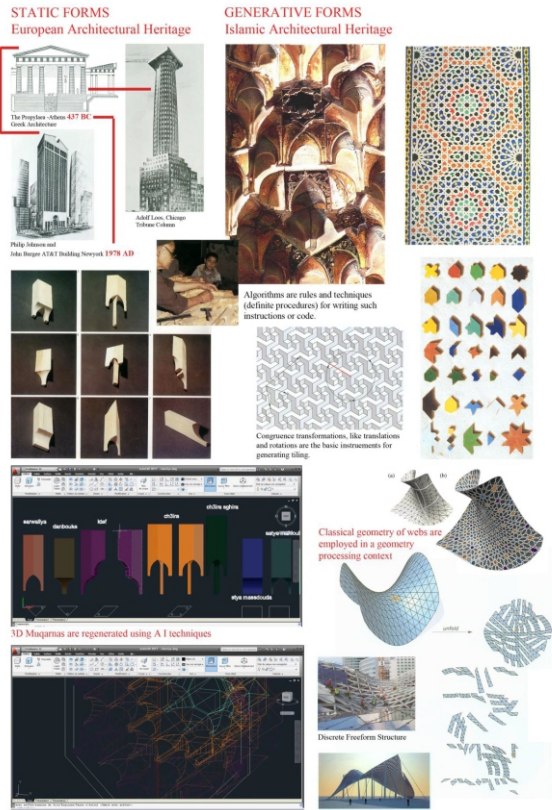observable fact meaning that aesthetically the do not meet each other, but are outdistanced occurrences.

Figure 3: Evolution of geometric models used in traditional art.

The concrete result of this disposition is radical change that operates between two absolute distinct and parallel spaces: one condensed and circumscribed by four walls, firmly limited in their upper part by the cornice; the other spreading infinitely beyond like a fragment of sky seen from an open air patio. Naturally such a conception for the ceiling cannot have come about by chance, must have resulted from a deliberate aesthetic intention – the desire to generate the visual sensation of endless space [6]. Seen in the phenomenological terms of anthropo-cosmology, this endless space could be equivalent to the infinite and unfathomable celestial realm. The boundless space of the Comares dome is a "pattern of intention", of expressing by resonance the dual metaphysical concept of immensity and infinity. In a broader perspective, the dome forms the pattern of the absolute space, to be included under the universal cosmic theorem of the imagination of the

celestial world that can be defined as: all that has the round morphology of a canopy vault refers to the vast firmament (Figure-4).

Speaking about absolute space Lefebvre's ontology may be useful as he notes that the word "space" was usually associated with Euclidean geometry, or was considered to be infinite, empty ether. He sought to bridge between the mental concept of space then being described by philosophers and epistemologist and the real physical implications of its social equivalent. Lefebvre settles on Hegel's "concrete universal" as a starting point in his search for a generative mechanism to replace the prevailing philosophical view of space as a static mental construct. He calls this mechanism "production", which, intentionally or not has connotations of manufacture goes far beyond discourse to provide a code that brings "the various kinds of space and the modality of their genesis together within a single theory" [9].

It was the aim of Islamic philosophers, as it was of the Christian medieval philosophers, to make a cosmos – a coherent whole- of their own experience or the experience of mankind. In other words to find truths about one's perceived environment. When we look at the solar system, from either the mechanical or the perceptual point of view, we see a series of concentric rhythms: from the point of view of the sun these rhythms, i.e. the path of the planets around the sun are in fact elliptical. From the point of view of the Earth, the planets travel in other kinds of rhythms, that is to say they appear to make orbital loops in the sky: this is due to the fact that we observe these orbits of the sun from our, i.e. the planet Earth's position within this system [1]. Similarly to Burckhardt the arabesque (Islamic art) "represents a perfect transcription of the laws of rhythm into visual terms. Like geometrical interlacement, it is "an extremely direct expression of the idea of Divine Unity underlying the inexhaustible variety of the world [3]. Islamic art is predominantly a balance between pure geometric form and what can be called fundamental bio-morphic form: a polarization that has associative values. The Islamic art of geometric form can be considered the crystallization stage, both of the intelligence inherent in manifest form and as a moment of suspended animation of the effusion of content through form [1].

4. THE NEW MODEL OF ARCHITECTURE

There is so far no general developed science of morphology, although the generation of form is fundamental to the creation of all natural and all designed

artefacts. Science is still searching for a theory of explanation, architecture for a theory of generation – and it is possible that the later will be advanced before the former. In other words, form- generating models developed for architectural

As a general rule, any type of aesthetic morphology is defined by the nature and content of this matter within space, namely the position of its limits, its horizon. Thus, the affirmation or on the contrary, the negation of the edges of this morphology constitutes a determining element for its ontological status, relative to the aesthetic dialectic between finitude and infinitude involved in the phenomenology of created visual spaces, above all in the phenomenology of pure geometric space [6].
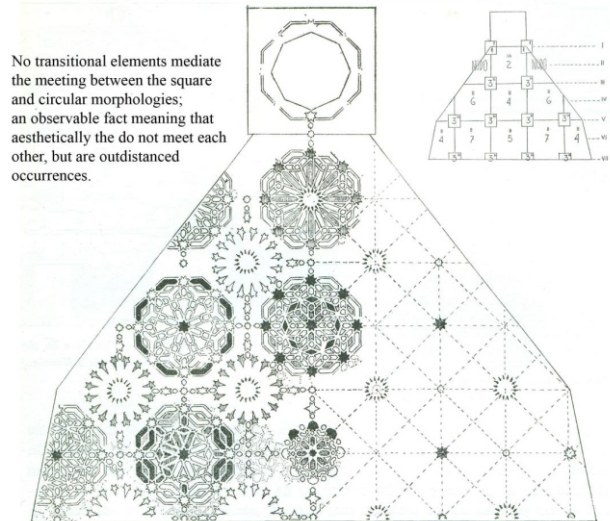

No transitional elements mediate the meeting between the square and circular morphologies; an observable fact meaning that aesthetically the do not meet each other, but are outdistanced occurrences.

Figure 4: Comares dome, the Alhambra-Granada, Spain 1370.

The idea behind digital design is comparable to the geometrical science of the Alhambra that comes from a highly sophisticated aesthetic conceptualisation where the geometrical constitution resulting from the pure mathematics of spatio-temporal shapes. They, in general, form the primary character of the generic concept of geometry and confer on geometrical arts the particular perceptual property of abstraction, as opposed to the property of figuration. Following the common

acceptance of both aesthetic notions, in art, abstraction basically consists of an elimination process of references to the matter towards thought, ideality, and ideas, whereas figuration, on the contrary, consists of a combination of references to matter in order to represent recognisable existing things and beings.

5. CONCLUSION

The process described before shows how we can use tools to generate a new model for the generative form process. The term tool does not imply that we regard these techniques in the dismissive sense implied by the phrase "a computer is just a tool"- as a means of reinforcing current practice rather than challenging it. This paper proved that architectural design process using CAD is fundamentally unsatisfactory in any known form, as soon as it will only reflect traditional non-CAD methodology. Instead, they should be tailored to make them acceptable to the designer's sensibility and concerned with creative morphology.

At the Alhambra, the palatine complex does not simply constitute a geometrical object or the material projection of an exercise of intelligence drawn into the shape of an architectural construction through complicated axioms and tabulations. If this were so, geometry would supply both the means and the end of the work of art, according to a single and univocal aesthetic principle. But on the contrary, the geometry in the Alhambra fulfils a plural function insofar as it transforms spaces, volumes and planes into different visual creations concealing different significations by means of a great diversity of aesthetic systems and through the elaborate use of the principle of variation. This means that, instead of a unified geometry, there is a conjunction of geometries in the Alhambra, or several geometrical propositions differing in content.

The regenerating of some of the classical geometry of webs used in Islamic patterns that were employed in a geometry processing using digital context proved that the approach used in this paper has yet more potential and

applications, in modern architecture. It has become apparent that methods from Geometric Computing bear a great potential to advance the field of freeform architecture derived from a geometry which is a priori non-quantitative and which is itself creative because it is linked to data inhering directly in the mind. This fact has created the new research area architectural geometry, which draws from various branches of geometry and which is motivated by problems originating in architectural design and engineering.

The Islamic heritage is an important link in the chain of man's progress. Their significant contributions in the fields of science have been recognized, but in its achievement in the field of design have been greatly under-estimated.

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STUDIES OF TREATMENT OF WASTEWATER TO PRODUCE GREEN ENERGY BY USING MICROBIAL FUEL CELL - A REVIEW

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ABSTRACT -Environmental protection and energy crisis are two major challenges human beings are facing today. As the energy sources decrease and the climate conditions change, demand for new and clean sources of energy has increased. Microbial fuel cell (MFC) represents a promising technology for sustainable energy production. Microbial fuel cell is one of the best alternative sources of green energy production which add wastewater to the list of renewable resources of energy. In this review, microbial fuel cell and its working have been briefly reviewed. Also different substrates that can be used in MFC and different factors affecting the performance of MFC have been briefly reviewed.

**Keywords: Microbial Fuel Cell, Wastewater Treatment, Electricity**

1. INTRODUCTION

Increasing global energy demands and over consumption of non-renewable resources of energy have led to search and use of renewable and cost-effective sources of energy. At present, global energy requirements are mostly dependent on fossil fuels. Combustion of fossil fuels also has serious negative effects on environment due to CO2 emission like global climate change, environmental degradation and health problems. This has intensified the search for alternatives to replace fossil fuels [1,2,3]. One of the renewable and green energy sources for the production of electricity is fuel cells (FC) [4,6]. Microbial fuel cells (MFCs) are a special type of FCs that has dual advantage. The microbes added convert organic matter into electricity and at the same time purify wastewater, thus may offset the operating costs of wastewater treatment plant [5,6]. The microbial fuel cell (MFC) is a new form of renewable energy technology that can generate electricity from what would otherwise be considered waste [7].

While the concept of bioelectricity generation was first demonstrated nearly a century ago, MFCs need to be considered as new technology. Biofuel cells conducted with yeast and bacteria that needed chemical mediators to be added to the reactor were very unlikely to have practical applications. Thus, modern MFCs can be considered to have only emerged in 1999 with the finding of electricity generation without the need for exogenous mediators. [8]

MFC converts organic matter present in wastewater into electricity through the catalytic activity of microbes. The energy present in C–C bonds of organic matter is directly converted into electricity. The electrons produced during the oxidation process are transferred to the anode from where they flow through the external circuit thus generating electricity. The electrons are transferred to the anode either through direct bacterial contact to the anode or through the use of mediators especially electrodes. [9]

Oxidation half- reaction (Anode chamber):

Biodegradable matter + bacteria⟶ CO2 + H+ + e- (anaerobic condition)
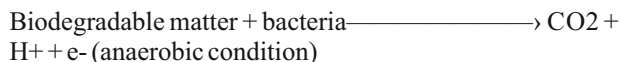
The electrons travel across the external circuit connected with an external resistance and reaches the aerated cathode where the electrons and the protons along with the molecular oxygen produce water completing the reduction half-reaction.

Reduction half-reaction (Cathode chamber):
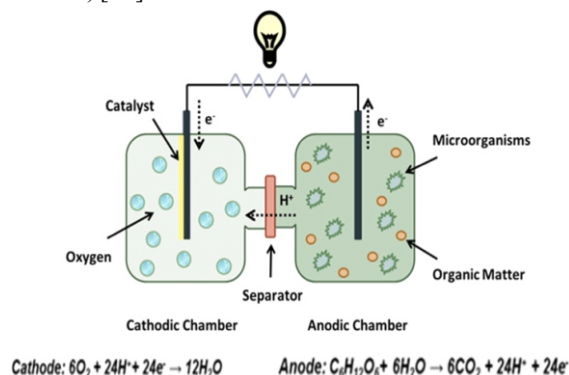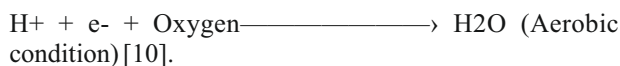
H+ + e- + Oxygen⟶ H2O (Aerobic condition) [10].

Cathode: $6O_2 + 24H^+ + 24e^- \rightarrow 12H_2O$ Anode: $C_6H_{12}O_6 + 6H_2O \rightarrow 6CO_2 + 24H^+ + 24e^-$

Figure 1: schematic diagram of the vortex tube (counter flow)

2. STUDIES ON DIFFERENT SUBSTRATES USED IN MFC:

In MFCs, substrate is regarded as one of the most important biological factors affecting electricity generation.

A variety of substrates can be used for bioelectricity generation in MFCs such as saccharides, organic acids, alcohols as well as inorganic substances e.g. sulphate. In addition, there is a significant research interest towards complex materials i.e. industrial and municipal waste streams, which are potential starting materials of power generation in MFCs because of their high organic matter content [12].

Wastewaters from chemical, distillery, brewery industries, pharmaceutical industry, textile, petrochemical, vegetable oil, food industries, animal carcass waste water, swine waste water, municipal waste water and domestic wastewater could be treated using aerobic or anaerobic MFC. Sulphide, ammonia, nitrate, nitrite, perchlorate, chlorinated compounds, copper, mercury and iron could be effectively removed by MFC [9].

Table 1: List of wastewater used as substrate in MFC studies.

Substrate	MFC Type		Power generation	References
Swine	Single chamber		261mW/m²	[13,14]
	Two chamber		45mW/m²	
Saline domestic sewage sludge	Two chamber		41W/m³	[15]
Nitrogen-containing organic compounds (pyridine andmethyl orange)	single-chamber air-cathode MFCs	Single MFC	502.5±17m W/m²	[16]
		Two MFC conne-cted in series	401.6±23 mW/m²	
Paper recycling wastewater+ 100mM PBS	Single chamber MFC		672±27 mW/m2	[17]
Urine	Two chambered		8mA/m²± 0.5mA/m²	[18]
Lemon peel waste	Dual chamber		371 ± 30 mW/m²	[19]
Domestic	Air-cathode		422mW/m²	[13,20]
Leachate	Air-cathode		344mW/m²	[13,21]
Starch	Air-cathode		239,4mW/ m²	[13,22]
Beer Brewery	Air-cathode		205mW/m²	[13,23]
	Single chamber		170mW/m²	

3. STUDY ON EFFECT OF PARAMETERS:

3.1 Effect of temperature:

Temperature is an important wastewater characteristic, but most studies have examined performance at a single temperature, with typical temperatures chosen of room temperature or higher (20–35°C). When temperatures have been varied during a study, different results have been obtained relative to impact of temperature on performance, although in almost all cases lowering the temperature reduced performance. In two different studies with single-chamber MFCs operated in fed-batch mode, the power density decreased by 10% when the temperature was reduced from 32°C to 20°C [24,25,26]. In another study with a single-chamber MFC operated with continuous mode, the power density decreased by 21% when the temperature decreased from 35°C to 24°C, but only by 5% when the temperature was decreased from 30°C to 24°C [24,27]. In contrast, it was reported that when using a two-chamber MFC with a ferricyanide cathode, that the power density was reduced by 39% when for a temperature decrease from 30°C to 22°C, and that there was no appreciable power generation at 15°C [24,28]. In another two-chamber MFC study with a dissolved oxygen (DO) catholyte, however, current increased from 0.7mA to 1.4mA when the temperature decreased from the range of 20–35°C to 8–22°C [24,29]. In a study it shows that upper temperature limit for MFC operation is 40°C and lower temperature limit is -5ºC. [30]

3.2 Effect of pH:

In a batch study, MFC have shown the best performance at anodic pH 7 and its performance decreases with increase in alkalinity and acidity of the substrate solution and show minimum voltage generation of 6.2 and 10.9 mV and minimum power generation of ~53 and ~3 mW/m2 at anodic pH 5 and 9, respectively.[31]

3.3 Effect of initial COD:

In a batch study, it is shown that that both voltage and power density increase with increase in time and become almost stable after around 5–6 days of operation for all the initial COD values. This is because of the adaptation of microbes in new environment. Voltage and power density in MFC increase with increase in initial COD value, reaches maximum at the initial COD value of around 1500 mg/L and then decreases. Maximum voltage and power density achieved after ~7 days of operation with 1500 mg/L initial COD are 14.8 mV and ~272 mW/m2, respectively.[31]

3.4 Effect of metal ions:

3.4.1. Effect of Chromium (Cr6+):

In a study, it is shown that both voltage and power density generation in MFC initially increases with increase in Cr6+ concentration upto 7 mg/L and decreases thereafter. The maximum voltage and power density generation after around 5 days of operation under the optimum concentration of Cr6+ (7 mg/L) are ~490 mV and ~508 mW/m2, respectively. These values are ~33 times and ~1800 times higher than the corresponding values of voltage and power density generation in absence of Cr6+.[31]

3.4.2. Effect of Iron (Fe3+) Concentration:

In a study, it is shown that both voltage and power density generation in MFC initially increases with increase in Fe3+ concentration up to 10mg/L and decreases thereafter. The maximum voltage and power density generation after around 5 days of operation under the optimum concentration of Fe3+ (10 mg/L) are ~321 mV and ~193 mW/m2, respectively. These values are ~22 times and ~709 times higher than the corresponding values of voltage and power density generation in absence of Fe3+.[31]

3.4.3. Effect of Zinc (Zn2+) Concentration:

In a study, it is shown that both voltage and power density generation in MFC initially increases with increase in Zn2+ concentration up to 8 mg/L and decreases thereafter. The maximum voltage and power density generation after around 6 days of operation under the optimum concentration of Zn2+ (8 mg/L) are ~135 mV and ~7 mW/m2, respectively. These values are ~9 times and ~26 times higher than the corresponding values of voltage and power density generation in absence of Zn2+.[31]

3.5. Effect of agarose concentration in salt bridge of dual chambered MFC:

In a study on performance of MFC with agarose concentrations 7,8,9,10,11 and 12 %. MFC with 10% agarose have produced maximum voltage and current and one with 12% produced minimum. The voltage developed showed a comparative hike from 7% agarose concentration to 10% concentration, and this could be due to the reason that as the concentration of agarose increases, the gel is highly polymerized, inhibiting the inter mixing probability of the two separated chamber fluids. Highly polymerized gel also prevents the entry of native and molecular oxygen from the aerobic chamber to the anaerobic chamber through the salt-bridge passage, maintaining the anaerobic conditions of the anode chamber. But a decrease in voltage production was observed for 11% and 12% agarose concentration, as the salt-bridge is highly polymerized reducing the pore size, hindering the movement of proton across the bridge.[10]

It was observed that there is an increase in current production as the concentration of agarose increases from 7% to 10%. This was due to effective proton transfer and as the gels is highly polymerized; it prevents the diffusion of oxygen from the cathode chamber to anode chamber through the salt-bridge, thus maintaining a better anaerobic environment in the anode chamber encouraging the growth of anaerobic bacteria for increased electrons release [32,10]. But there was a decrease in current production for 11% and 12% agarose concentration as the extremely polymerized gel prevents the effective movement of protons, increasing the concentration of protons in the anode chamber, reducing the pH, making the anodic environment highly acidic for the microbes to survive [10].

3.5 Effect of spacing between anode and cathode on power production:

In a study under variable external resistance, the power density has increased with decrease in distance between the electrodes. Maximum power density of 10.9, 8.6, and 7.4mW/m2 was observed at electrode spacing 20, 24 and 28 cm, respectively. The maximum power density was observed at external resistance between 900 ohm and 1200 ohm. Decrease in power density was observed with increase in resistance beyond 1200 ohm, indicating importance of external load for controlling power production. These results suggest that, at higher external resistance the electron transfer through the external circuit to the cathode might be the limiting factor. In addition, this suggests that, ML–MFC should be constructed by placing electrodes as close as possible to increase power output.

4. CONCLUSION:

With the above review following conclusion may be drawn:

- Microbial fuel cell (MFC) is a promising technology may be proved in future to fulfill the needs of energy.

- It is also a promising technology for treatment of

wastewater as well as alternative sources of green energy production.

• Its power production is still low for the practical applications thereforefurther extensive studies will be required for practical applications.

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STUDY OF LANDFILL LEACHATE TREATMENT USING PHOTO-FENTON PROCESS - A REVIEW

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ABSTRACT - Abstract: Landfilling is the most common method of solid waste management in our country. Leachate management is a major problem concerned with landfill. Leachate can pollute surface and subsurface water sources. Various studies have been done to obtain effluent of discharge standards. Advanced oxidation processes such as photo-fenton is an effective treatment method in which hydroxyl radicals are generated which help in pollutant degradation. Here, we review conventional treatment methods ,the effect of different parameters such as dosages of hydrogen peroxide, ferrous ion, temperature, initial pH, reaction time and radiation intensity on the efficiency of photo-fenton process. We also summarize different integrated system for leachate treatment using photo-fenton and other processes.

Keywords: Landfill leachate, photo-fenton, hydroxyl radical, integrated leachate treatment.

1. INTRODUCTION

The landfill is the most common technology used to dispose municipal solid residues in developing countries. Surface water that percolates through the landfill and leaches out organic and inorganic constituents from the solid waste is termed as leachate. Landfill leachate production starts at the early stages of the landfill and continues several decades even after landfill closure. Landfill leachate is mainly generated by the infiltrating water which passes through the solid waste fill and facilitates transfer of contaminants from solid phase to liquid phase [1].

Leachate may contain large amounts of organic matter (biodegradable, but also refractory to biodegradation), where humic-type constituents make an important group [2], as well as ammonia-nitrogen, heavy metals, chlorinated organic and inorganic salts [3]. At the same time, the characteristics of the leachate also vary with regard to its composition and

volume, and biodegradable matter present in the leachate against time[4]. The pH of initial landfill is 4.5 - 7 and can go up to 6.6 - 7.5 with passage of time. The BOD will go up to the maximum value when the normal land filling is processing from 6 months to 2 years. The BOD becomes very deliquescent, which is a main characteristic of BOD. Finally, the BOD start to reduce until the landfill is steady should through 6 - 15 years .Effluent COD values are 3,000 – 60,000mg/l [5]. Leachate may also have a high concentration of metals and contain some hazardous organic chemicals [6].

Many different methods are currently in use to treat the landfill leachate. Advanced oxidation process (AOPs) use the hydroxyl radicals for the degradation of pollutants. One available technology widely used to treat landfill leachate in recent years is Fenton's oxidation process (H_2O_2+/ Fe^{2+}) , which has the advantages of both oxidation and coagulation processes [7] . The wastewater treatment by the overall Fenton process consists of four stages, such as oxidation, neutralization, coagulation/ flocculation, and solid-liquid separation. In the Fenton treatment, the oxidation proceeds mainly by hydroxyl radicals and the coagulation by ferric-oxyhydroxides precipitation. Both processes contribute to the reduction of organic constituents [8].

The degradation of organic pollutants by Fenton-type processes can be significantly accelerated in the presence of ultraviolet light irradiation [9]. The organic matter present in the effluents was oxidized, rather than mineralized, higher percentage removals of COD, BOD, and TOC, respectively, having been observed. For this reason, the photo-Fenton process increased BOD/COD ratio, but reduced BOD/TOC ratio [10]. UV photo-fenton can also be done in the presence of catalysts such as TiO_2 which is found to increase the treatment efficiency of the process [11]. Solar radiation was found more effective than UV in COD removal. The photo reduction of Fe^{3+} by sunlight maintains the concentration of Fe^{2+} in the

reactive medium, guaranteeing the efficiency of the photo-Fenton process even in treatments with low initial concentration of ferrous ions [10]. Solar photo-fenton was also studied as pre-treatment method before biological processes such as activated sludge process. The biodegradability of wastewater has enhanced from 0.19 to 0.4 (measured as BOD3/COD ratio) after 40 min photochemical treatment time . A COD removal of 88% was observed in one hour photochemical treatment time [12].

2. OTHER TREATMENT METHODS

To treat these landfill leachates, many physical / chemical (chemical oxidation, chemical precipitation, coagulation-flocculation, activated carbon adsorption and membrane processes) and biophysical processes have been used [13].

Coagulation and flocculation is a relatively simple technique that may be employed successfully in treating old landfill leachates . However, this treatment only leads to moderate removals of COD and TOC, and it has its drawbacks: sludge is produced, and in some cases, when traditional chemical coagulants are used, an increase on the concentration of aluminium or iron, in the liquid phase, may be observed [14]. Lime treatment alone provides removal efficiencies of approximately 50% of the organic matter. The complete chemical-physical treatment sequence consisting of lime precipitation/sedimentation/ammonia stripping achieved the removal efficiency of 48%-69% of the organic matter[15]. A study showed that EC is an efficient process for treating stabilized leachate. A 67% COD removal was observed when electrocoagulation was performed for an electrolysis time of 30 min and a current density of 666.6 A/m2. The conductivity of the sample increased when fly ash C, fly ash F, and bottom ash were introduced into it [16]. Activated carbon adsorption systems have also been used in the treatment of landfill leachates for the removal of dissolved organics, however, they are generally considered as one of the more expensive treatment options and often, must be combined with other treatment technologies to achieve desired results [17]. The most common biological treatment is activated sludge, which is a suspended-growth process that uses aerobic microorganisms to biodegrade organic contaminants in the leachate [18,19]. Biorefractory contaminants, contained mainly in older leachate, are not amenable to conventional biological processes, whereas the high ammonia content might also be inhibitory to activated sludge microorganisms [20].

Table 1: Characteristics and Classification of Landfill Leachate Based on Age [46,47].

Parameters	Young	Intermediate	Old
Age (years)	< 5	5-10	>10
pH	<6.5	6.5-7.5	>7.5
COD(mg/L)	>10,000	4,000-10,000	<4,000
BOD_5/COD	0.5-1.0	0.1-0.5	<0.1
TOC/COD	<0.3	0.3-0.5	>0.5
Ammonia nitrogen (mg/L)	<400	-	>400
Heavy metals	Low to medium	Low	Low

3. Effect of parameters

3.1 Effect of H_2O_2 dosage

H_2O_2 dose is a critical variable in the process. A low concentration of H_2O_2 did not generate enough OH in solution. Addition of H_2O_2 above optimum will lead to decrease in hydroxyl radical concentration due to free radical scavenging by the excess H_2O_2 [21,22]. So there was an optimum H_2O_2 concentration to achieve the maximum percentage of removal although the definition of the concentration range varies for different contaminated wastes [23,24]. Excessive application of hydrogen peroxide generates gas bubbles, which inhibits sludge sedimentation [26,27]and may be detrimental to biological treatments a posteriori [28]. In a study [25], the photo-Fenton treatment was mediated by a $[H_2O_2]/[Fe^{2+}]$ ratio = 114, and after a total irradiation of 90 kJ/L, it achieved 96.5% removal efficiency for TC, 63.0% for COD, and 75.9% for NH^{4+}.

The effect of mode of reagent addition was also studied by [29]. These authors reported that there was an additional increase of about 10% in COD removal when the reagents were added in a continuous mode rather than when all reagents were added simultaneously in batch mode. Similar results were obtained in other studies [30,31].

3.2 Effect of Fe^{2+} dosage

The amount of ferrous ions is one of the primary parameters that influences the Fenton and photo-Fenton processes. In a study [32], it was observed that the extent of degradation increases with increasing initial Fe^{2+} concentration. Particular attention must be paid to Fe^{2+} dosage in order to avoid the following undesired HO

radicals scavenging reaction occurring in the presence of an excess of Fe^{2+} [33] .

$$Fe^{2+} + OH \longrightarrow Fe^{3+} + OH^- . \qquad (1)$$
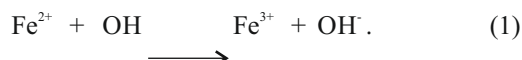
Naturally, an excessive dosage of iron can contribute to a significant increase in total dissolved solids (TDS) and electrical conductivity in the effluent. Excessive iron salt dosing requires further treatment of the effluent before its discharge to the receiving water [28]. According to [34], the optimum iron concentration in solar photo-fenton depends essentially on the light source, photo reactor configuration and dimensions and the type of wastewater to be treated. In photo-fenton, the presence of light absorbing species such as fulvic acids , nitrates also affect the optimum iron concentration value [35].

3.3 Effect of initial pH

The solution pH plays an important role in the efficiency of the photo-Fenton reaction, since it greatly influences the molar fraction of the iron-water complexes., iron-organic complexes (e.g. oxalic, formic, etc.) and iron-inorganic complexes (e.g. chlorides, sulphates, etc). [36] indicated that pH 2.8 avoids Fe^{3+} precipitation, and the predominant iron-water species in solution is $FeOH^{2+}$, which is the most photoactive ferric ion water complex and can absorb light until 410 nm.

[37] explained higher hydroxyl radical product yields in the pH range of 2–4 by a reaction involving the organometallic complex where either hydrogen peroxide is regenerated or reaction rates are increased.

3.4 Effect of reaction time

Reaction time above an optimum doesn't give significant increase in pollutant removal efficiency. According to many studies [38,33], optimum reaction time for photo-fenton is 2 h with less sludge production.

3.4 Effect of Temperature

In a study, it was observed that there was no significant increase in COD removal when temperature was increased from 25 to 45 °C by the conventional Fenton process [30]. As temperature increased from 13 to 37 ◦C, COD removal efficiency increased from 90.3% to 94.3%, from 71.4% to 78.5%, and from 66.6% to 76.6% when initial COD was 1000, 2000, and 3000 mg/L, respectively. Higher temperature was beneficial for organic removal, even though the increase of organic removal is relatively small [39].

In solar photo-fenton , the increase of leachate temperature had a positive effect on the reaction rate, increasing 4 times by raising the temperature from 10^0 C to 40 ^{0}C.This is due to production of more hydroxyl radicals resulting from a higher ferric ion reduction rates through thermal reactions [40].

3.5 Effect of radiation intensity

The rate of initiation of photo catalysis and electron-hole formation in the photochemical reaction is strongly dependent on the light intensity[41]. While increasing the intensity of incident light, the probabilities of excitation of electrons as well as the re-excitation of recombined electrons increase. Hence, increase in the degradation is observed with increase in the intensity of incident light [42]. In some cases, the reaction rate exhibited a square root dependency on the light intensity; others observed a linear relationship between the two variables[43,44]. In a study [45],the optimum radiation required was 57.4 kJ/L of solar UV energy.

4. Integrated leachate treatment with photo-fenton and other processes.

In photo-fenton process, the initial turbidity should be less to make use of the radiation . Also, the effluent should be treated to obtain the discharge standard. An integrated system with photo-fenton and other processes gives the best results. The treatment of medium-age landfill leachate was investigated by employing several set-ups including

a sequencing batch bio-filter granular reactor (SBBGR) step, with ozone enhancement, followed by a polishing stage with solar photo-Fenton [48]. For the target COD 160 mg/L, the combination SBBGR + solar photo-fenton needed 4.1 €/m^3.

Another study [49] was done to evaluate the suitability to couple anammox process with advanced oxidation processes (ozonation + photo-fenton) to treat mature landfill leachate with high nitrogen and non-biodegradable organic matter concentrations. Total COD removal efficiency of 98% and total nitrogen removal efficiency of 89%was obtained. Also, physical-chemical treatment followed by solar photo-fenton and then biological treatment enhances the biodegradability of leachate [50,52,59].Post treatment of aerated landfill leachate with fenton also improved the COD and color removal efficiencies rather than increasing the fenton

reagent's dosage[51]. Similarly in a study [53], multistage treatment of leachate combining biological nitrification-denitrification / solar photo-fenton / biological process gave effluent of discharge standard.

Table 2 : Integrated leachate treatment with corresponding treatment efficiencies.

Treatment combination	Parameter with removal %	References
Aerated lagoon + Photo-fenton + ASP	DOC - 90 % Nitrogen -100%	[54]
SBBGR + solar photo-fenton	COD -95%	[48]
Annamox + photo-fenton	COD - 98%	[49]
Aeration +Fenton + Biological	COD - 89% Color - 97%	[51]
Electrocoagulation + solar photo-fenton +Biological	COD - 90%	[55]
Solar photo-fenton + Biological oxidation	Nitrogen - 100%	[56], [58]
Aerated lagoon + photo-fenton + ASP	Polyphenol 82% DOC - 75%	[57]

5. Conclusion

Landfill leachate management is a major issue which has to be handled properly. Leachate is heavily polluted and thus detrimental to surface and subsurface sources. In the recent years, with the continuous hardening of the discharge standards in most countries and the ageing of landfill sites with more and more stabilized leachate, conventional treatments (biological or physic-chemical) are not sufficient anymore to reach the level of purification needed to fully reduce the negative impact of landfill leachate on the environment.

Photo-fenton process is an efficient method for the degradation of biodegradable and non-biodegradable organic matter in the landfill leachate. Various parameters such as reagent dosage, initial pH, reaction time, temperature , radiation intensity affects the process. Reagent dosage above optimum reduces the efficiency and produces more sludge. An acidic pH range of 2-4 is optimum for photo-fenton process. Temperature increase doesn't have much impact on conventional fenton process ,but in photo-fenton it has a positive impact.

Turbidity affects the photo-fenton efficiency. Thus, pretreatment increases the efficiency .Also, post-treatment of photo-fenton treated leachate by biological process gives better results. Integrated system using physic-chemical ,photo-fenton and biological process gives effluent of discharge standards.

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FLIGHT CONDITIONS FOR ROTATING CYLINDRICAL WING

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ABSTRACT - Analysis of conventional wing dynamics exhibits limits imposed by physical laws which cannot be fully compensated by wing profile optimization nor by artificial flow lines modification. A different alternative is proposed by modifying drastically wing shape into a tubular one. It is shown here that such wings take advantage of their geometry allowing an enhanced new lifting effect produced by the apparent velocity due to the combination of their velocity with a rotation around their symmetry axis. At the same time this rotation generates a gyroscopic stabilization of the wing around its symmetry axis during its trajectory which can be more easily controlled for a large range value of angle of attack. In particular there results a much larger value of stall angle. These theoretical results have been verified by preliminary observations on a small size 3D printed model.

1. INTRODUCTION

Aeronautics are developed on basic concepts of lift and drag which are opposed to weight and thrust. However the matching of their antagonism has principally been thoroughly studied within very classical "plane" wing configuration with typical Joukovski profile [1]. Performance has been largely improved since early beginning of manned flights over a large range of dimension parameters by better design of the wing itself [2], by adding additional rudders and ailerons [3] to manage in best way the different stages of usual flight (take-off, stationary flight, approach and landing), by modifying propulsion system for higher efficiency [4], or even by managing flow lines circulation to take better advantage of flow relative speed in a more integrated approach [5]. None of these studies has been questioning the basic "plane" wing concept. It is possible nevertheless to wander if the choice of this elementary structure of course very easy to design is always optimal one, and if other more sophisticated structure could not be more appropriate to handle the basic flight antagonisms. Amongst possible extensions, simplest one is to conceive a different wing structure, and attention will be focused in the sequel on tubular wing. This is still a relatively simple structure with corresponding periodicity constraint, a priori leading to different airflow organization around it. Very few experimental flights have been tested for such systems mainly developed as vertical take-off and landing (VTOL) systems [6], such as the SNECMA "Coleopteres" some 55 years ago, the last one of which did crash while trying to get to horizontal flight. There is no available report today on such wings when operated as a regular flying object. In fact the complete flight analysis of this type of wing is not entirely clarified especially when it is rotating around its symmetry axis. An interesting toy is the X-Zylo available for observations, though its small size, thin thickness and soft surface may impact the observations and especially stall angle value. To proceed, it is proposed here to develop first a theoretical framework where the role of relevant system parameters can be analyzed in order to evaluate their effect on cylindrical wing dynamics. In a second part, experimental observations on a modest size 3D printed cylindrical wing in a wind tunnel will be discussed. Very interesting result is that, opposite to regular plane wing which shows a maximal lift for relatively slow relative wind velocity, tubular wing exhibits a lift improvement produced by the combination of different effects related to cylindrical wing rotation for adapted geometric parameters which can then be determined without needing much higher velocity.

II. Tubular Wing Dynamics

Like any identified object, cylindrical wing of radius R and half-length h can be represented in 3D-space with a (mobile) three-orthogonal system of coordinates (G_x, G_y, G_z) attached to its center of gravity G with G_z along cylinder axis. It will also be represented in fixed reference frame (O_X, O_Y, O_Z) with O_Z pointing upward, see Figure **1**. It is possible to pass from fixed to mobile frame by two successive rotations $R_Z(\psi)$ around O_Z and $R_X(\phi)$ around O_X. So a point P(x,y,z) in mobile frame will have in fixed one the coordinates

$$X = X_G + x \cos\psi \cos\phi + y \sin\psi + z \cos\psi \sin\phi$$
$$Y = Y_G - x \sin\psi \cos\phi + y \cos\psi - z \sin\psi \sin\phi \quad (1)$$
$$Z = Z_G - x \sin\phi + z \cos\phi$$

where (X_G, Y_G, Z_G) are the coordinates of G in fixed frame. Writing $\Delta X = X - X_G$, $\Delta Y = Y - Y_G$, $\Delta Z = Z - Z_G$ and letting M be the wing mass, its kinetic energy is given by

$$\mathcal{E}_c = (1/2)MV_G^2 + (1/2)\Sigma\{(d\Delta X/dt)^2 + (d\Delta Y/dt)^2 + (d\Delta Z/dt)^2\}dM \quad (2)$$

and from (1) after some calculations one gets

$$\mathcal{E}_c = (1/2)MV_G^2 + (1/2)\Sigma\{[dx/dt - y \cos\phi \, d\psi/dt + z \, d\phi/dt]^2 + [dy/dt - d\psi/dt (x \cos\phi + z \sin\phi)]^2 + [dz/dt + y \sin\phi \, d\psi/dt - x \, d\phi/dt]^2\}dM \quad (3)$$

in mobile frame.

The forces acting on the flying object are the weight **W** along the vertical O_Z, the thrust **T**, and drag and lift forces $\mathbf{F}_D$ and $\mathbf{F}_L$ respectively parallel and perpendicular to free-stream air flow direction, and related to propulsion and antagonistic reactions of the air against moving object respectively due to friction and to pressure change, see Figure **2**. To allow application of similarity laws from sub-scale wind tunnel experiments, the last two forces are expressed in non-dimensional form through drag and lift coefficients C_D and C_L

$$\mathbf{F}_J = (.5\rho V^2 S) \, C_J \quad (4)$$

where $J = L, D$, ρ is air density, V its velocity with respect to flying object, S a typical object surface. Forces $\mathcal{F}_K$ can be projected on the G frame intrinsic to the object with axial, side and normal coefficients C_x, C_y, C_z, or on the one aligned on the direction of motion with corresponding drag, side force and lift coefficients C_D, C_y, C_L. Evaluation of C_D and C_L is depending on correctness of flow lines representation around the object and is often determined by experimental observation. From basic dimensional analysis calculation, the general expression of force **F** acting on an immersed body in a fluid stream implying body and geometric sizes L_j, (j=1,2,..), stream velocity V, fluid density ρ, fluid viscosity μ, surface tension σ, modulus of elasticity K and gravity g, ie $\mathbf{F} = f(L_j, V, \rho, \mu, \sigma, K, g)$ can be reduced to non-dimensionalized form $\mathbf{F} = \rho V^2 L^2 g(\mathcal{R}e, \mathcal{F}r, \mathcal{W}, \mathcal{M}, \lambda_j)$ with Reynolds number $\mathcal{R}e = \rho VL/\mu$, Froude number $\mathcal{F}r = V/(gL_1)^{1/2}$, Weber number $\mathcal{W} = V^2 L_1 \rho/\sigma$, Mach number $\mathcal{M} = V/(K/\rho)^{1/2}$ and length ratios $\lambda_j = L_j/L_1$. When surface tension, elasticity and gravity effects can be neglected, one is left with $\mathbf{F} = \rho V^2 L^2 g(\mathcal{R}e, \lambda_j)$, so from (3) $C_J = g_J(\mathcal{R}e, \lambda_j)$. Coefficients C_J are also depending on the angle of attack (AoA) α between axis of symmetry and thrust so $C_J = g_J(\mathcal{R}e, \alpha, \lambda_j)$.

Main difficulty is here in the effect of the different acting parameters. For geometric parameters λ_j, some results are summarized on Figure **3** for drift coefficient and for cylindrical structure. In simplest case of plane structure and $\alpha = 0$, one gets from analysis of boundary layer the expression $C_D = a/\mathcal{R}e^{1/2}$ in laminar case, where parameter a is depending on used profile (exact calculation gives $a = 1.328$). For turbulent case boundary layer enlarges and experimental observation gives a dependence mocked up by $C_D = b/\mathcal{R}e^{1/5}$ (or $c(\log_{10} \mathcal{R}e)^{-2.58}$). Drag force contains also a small quadratic induced component due to lift generation. Lift is produced by pressure difference between upper and lower surfaces of flying object and requires calculation of pressure variation along air flow line circulation around flying body. It is thus depending on difference of flow lines effect above and below flying object.

III. Trajectory Analysis

Amongst all possibilities, interesting trajectories are characterized by small variations of symmetry axis direction during the flight (small variation of pitch and yaw angles). When $\alpha \neq 0$, there is a torque $\Psi(\alpha)$ resulting from unbalance between forces produced by flow pressure on inner (concave) and

outer (convex) parts on the flying tube, see Figure **4**, which contributes to increase α and make system trajectory more hectic. To cure this defect, another degree of rotation will be given the system with frequency ω around its symmetry axis through G to produce counterbalancing gyroscopic effect. Interesting side advantage is considerable lift increase resulting from enhanced flow circulation around flying object as discussed below. This will end up with lift and drag expression $C_j = g(\mathcal{R}e, \lambda_j, \Omega)$ with new dimensionless parameter $\Omega = \omega L_k/2V$ where k refers to object dimension in the plane perpendicular to rotation axis.

To evaluate flow effects related to surface convexity (typically in experiments drag coefficient varies by a factor up to three between convex and concave surfaces), rotating tubular wing will be split into three parts with respect to flow lines : 1) a convex region S_+, 2) a fully circled region S_f 3) a concave region S_-, depending on "apparent" flow line angle β around the tube, see Figure **4**. Apparent flow lines are constructed as vector combination of applied flow velocity and tube rotation ie $V_a = V + [\omega R]$ tangential to the cylinder with components $\{0, \omega R + V\sin\alpha, V\cos\alpha\}$ in cylindrical coordinate frame $\{G_r, G_\theta, G_z\}$ at G. So instead of initial wind angle α, apparent one is $\beta = Arctg\{[\Omega + \sin\alpha]/\cos\alpha\}$ with $\Omega = \omega R/V$. If $\beta > \gamma = Arctg(R/h)$ ie if

$$\cos\alpha/[\Omega + \sin\alpha] < h/R = \lambda \quad (5)$$

there exists flow lines circling around the cylindrical wing along an ellipsis corresponding to the cut of cylindrical wing by helical normal plane at angle β, thus defining fully circled region S_f, whereas other regions $S_\pm$ are respectively after and before S_f on the cylinder, see Figure 4. Surface S_f covers a strip of width $2d = 2R[\lambda - cotg(\beta)]$ and in this region, flow lines develop an extra lift force which strongly changes system dynamics, aside beneficial gyroscopic effect stabilizing cylinder direction during its motion. They are circulating around the elliptic cross section $\mathcal{E}$ of cylindrical rotating wing at angle β, and can be derived from complex potential

$$W(z) = V \{z \exp(-i\beta) + c^2/z \exp(i\beta) - i\Omega \, Logz\} \quad (6)$$

with $c = .5Rtg\beta$, reducible to circular cross section case by conformal transformation $Z = z + c^2/z$. Lift $\mathbf{F}_{Lf}$ and torque $\mathbf{M}_f$ are then obtained in the form

$$\mathbf{F}_{Lf} = .5i\rho\int_\varepsilon (dW/dZ)^2 dZ \; ; \; \mathbf{M}_f = -.5\rho \, \mathcal{R}e\{\int_\varepsilon Z(dW/dZ)^2 dZ\} \quad (7)$$

where the integral is performed on closed elliptic curve $\mathcal{E}$. Returning to variable z, developing the two integrands in Laurent series and keeping the only contributing term in $1/z$, one gets with (4) the coefficients

$$C_{Lf} = -4\pi\Omega\sin\beta \qquad ; \qquad C_M = -\pi tg^2\beta\sin2\beta \quad (8)$$

showing that for large ω, lift force can be large with correct rotation sign. There is no drag contribution due to up-down symmetry in this part.

Other regions $S_\pm$ are contributing to a drag force and a torque due to unbalance in flow impact on convex (exterior) and concave (interior) walls. Due to cylindrical tube hollowness, on top of usual drag-lift effects corresponding to cylindrical tube convex hull, analysis should also include direct impact of flow lines onto accessible tube interior. Analysis of flow impact along parallel strips to cylinder axis shows that each elementary flow tube creates longitudinal and radial forces the last one through the axis. Their strength is proportional to the angle of impact on interior tube surface for each strip and to strip length (up to ellipse section end, or only to interior and opposite tube edge), see Figure **5**. Analysis of the radial local force on each interior element of tube surface directly accessible to flow impact gives finally a resulting force acting perpendicularly to cylinder axis in the direction of angle of attack, see Figure **5**.

Defining $Z(\xi, \theta) = \xi\sin\theta + (1 - \xi^2\cos^2\theta)^{1/2}\Gamma(\pi - \theta)$, $Y(\xi, \theta) = Z(\xi, \theta)cotg\alpha \, \Gamma[2\lambda - Z(\xi, \theta)cotg\alpha]$ ($\lambda = h/R$), where $\Gamma(x) = 1$ if $x > 0$ and 0 if $x < 0$, the normalized quantity

$$\mathcal{F}_n(\xi, \theta) \, \xi d\theta d\xi = Y^n Z^2 [\xi^2\cos^2\theta + Z^2]^{-1/2} [Y^2 + Z^2]^{-1/2}\cos\theta . \xi d\theta d\xi \quad (9)$$

represents for n = 0 the resulting force acting on the axis of the cylindrical tube perpendicular to it at abscissa Y in the symmetry plane (G_Z, G_V) where G_V is the unit vector along velocity V and produced

by the flow line through elementary surface $\rho d\theta d\xi$ in cylinder cross section at point $M(\rho\cos\theta, Z(\xi,\theta))$. When summed up, the distributed local forces onto the directly impacted interior cylinder surface are producing a lift $\mathbf{F}_{l,f}\cos\alpha$ and a drag $\mathbf{F}_{Lf}\sin\alpha$ at G, and a total torque around G, applied at point M $(0,0,z_M = \mathcal{J}_1(\alpha,\lambda)/\mathcal{J}_0(\alpha,\lambda))$ in (G_x,G_y,G_z)-frame given by $\boldsymbol{\Psi}_f(\alpha,\lambda) = z_M F_{Lf} = 2\rho_f V^2 R^2 z_M \mathcal{J}_0(\alpha,\lambda).\sin\alpha$ with $\mathcal{J}_n(\alpha,\lambda) = \iint_{\mathcal{D}} \mathcal{F}_n(\xi,\theta).\xi d\theta d\xi$ and $\mathcal{D} = \{[0,2\pi],[0,1]\}$, the effect of which is to increase the angle of attack α. It is easily seen by construction that z_M is the smaller as λ is smaller because unless α is very large, flow lines are almost equivalently hitting both interior half cylinder parts on each side of G, reducing in proportion the finally produced torque as z_M becomes very small. When z_M is 0, the total force acting onto G reduces to enhancement of lift force $\mathbf{F}_{Lf}\cos\alpha$ and drag $\mathbf{F}_{Lf}\sin\alpha$. Interestingly, lift force increase induces an increase of stall angle allowing the system to be operated in larger AoA α parameter space as it can be calculated from previous analytical expressions.

IV. Gyroscopic Stabilization

To further reduce the consequences of produced torque on trajectory guidance, advantage will be taken of cylinder rotation. From (8) interesting lift enhancement has already been obtained. In parallel, strong classical gyroscopic effect is expectable if rotation is large enough. If frictions are neglected, with $x = R\cos\theta$, $y = R\sin\theta$, Lagrange rotating cylindrical tube equations simplify from (3) to dynamical part concerning cylinder displacement as a whole represented by its center of gravity G under the action of its weight and exterior lift and drag forces, and its rotation part in 3D space with rotation vector $\Phi = \theta'G_z + \alpha'G_u + \psi'G_Z$, where G_Z is parallel to O_Z by G and $G_u = G_z \wedge G_Z$ the unit vector from G along the intersection of (G_x,G_y) and (G_X,G_Y) planes, where G_X,G_Y are parallel to O_X,O_Y by G. From now on, nutation angle ϕ is the angle of attack α with G_Z direction along cylindrical wing velocity. When projected on more convenient Résal base (G_u,G_v,G_z) with $G_v = G_z \wedge G_u$, kinetic moment writes $L = A\phi'G_u + A\psi'\sin\phi\, G_v + C(\psi'\cos\phi + \theta')G_z$, and for circular hollow cylinder diagonal inertia matrix $\mathcal{M} = \text{diag}[A,A,C]$ where $A =$

$MR^2(\lambda^2/3 + 1/2)$, $C = MR^2$ and M is cylinder mass. Kinetic moment equations then write

$$\alpha''$$
$$+ \psi'\sin\alpha(br_0-\psi'\cos\alpha) = A^{-1}z_M F_{Lf}$$
$$(\psi'\sin\alpha)' - \alpha'(br_0-\psi'\cos\alpha) = 0 \quad (10)$$
$$\psi'\cos\alpha + \theta' = r_0$$

with $b = C/A$. Multiplying second equation by $\sin\alpha$ transforms it to $(\psi'\sin^2\alpha - br_0\cos\alpha)' = 0$ from which $\psi'\sin^2\alpha - br_0\cos\alpha = q_0$. With two first integrals q_0, r_0 system (10) reduces to a single equation which has been studied as the Lagrange-Poisson case [7] with complete rotation-precession-nutation effects. Here to bound these effects, one will be interested in situation where cylinder rotation dominates ie when $\theta' >> \psi', \alpha'$ in gyroscopic approximation. In this case, initial condition θ'_0 dominates and r_0 is very large from third equation. System (10) reduce to lowest order in $\varepsilon = (br_0)^{-1}$ to

$$\theta' = r_0 \quad ; \quad \psi'\sin\alpha = \varepsilon A^{-1}z_M F_{Lf} \quad ; \quad \alpha' = 0 \quad (11)$$

Then the internal motion of cylindrical wing reduces to its rotation around its symmetry axis with fixed angle of attack (no nutation) and a slightly varying precession depending on the amplitude of the right hand side of second equation. Different situations can be expected depending on the value of system parameters λ, α and ω contributing to the three main effects : an enhanced lift, a larger stall angle and a gyroscopic stabilization of cylinder axis direction, which can be combined to get "best" desired trajectories as it will be discussed elsewhere for various applications.

V. Experimental Observations

In agreement with previous dimensional analysis, a broad range of preliminary observations have been developed in academic environment on simple 3D printed model with geometric parameters $R = .1m$ and $\lambda = .5$. The wind tunnel consisted of an extraction fan surrounded by a Depron (extruded expanded polystyrene) chamber. Experiments have been conducted at 1013 hPa atmospheric pressure and 20°C ambient temperature, for three different speeds and five angles of attack. The results displayed on Figure **6** are showing the lifts

generated by cylindrical wing model and a flat wing without any profile and same area as cylindrical one. Remarkably, and as theoretically predicted, observed result is, even without rotation, a large augmentation of stall angle beyond 30°, to be compared with critical stall angle 20° for regular flat wing, and beyond which lift decreases massively especially for low velocity.
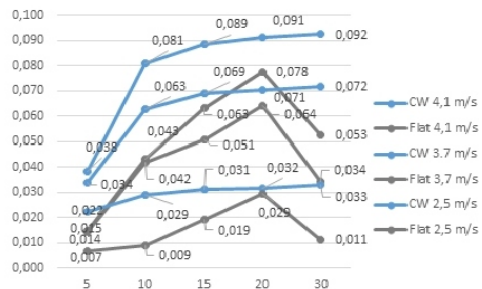

Figure 6. Lift (Newtons) vs Angle of Attack (AoA °) for Tubular
(Blue) and Planar (Black) Wing and Different Wind Velocities

VI. Conclusion

To enlarge parameter domain of flying objects, new type of hollow cylindrical wing has been considered. It is mainly shown that such system exhibits very interesting flying properties when it is given the possibility to rotate. Basically, for non-zero angle of attack, hollowness destabilizes the trajectory by direct flow impact on interior surface of the cylinder which creates a torque increasing the angle of attack and generating very unfavorable precession and nutation motions. However, it is shown here that this effect can be compensated by adapted gyroscopic effect produced by rotating the cylindrical wing along its axis of symmetry above a critical threshold. At the same time, the resulting combined circling of flow lines around the cylinder tube considerably enhances the lift force. Another consequence is the displacement of stall angle to higher value giving even better flight stability Such result suggests that there exists in system parameter space a useful domain where lifting and stabilizing effects are particularly efficient to master flying trajectory of a system based on this principle, as it will be discussed elsewhere.

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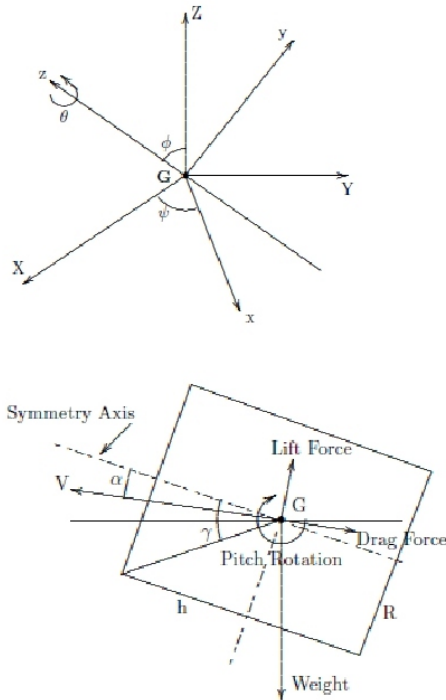
Figure **1**. Systems of Coordinates from Center of Gravity G (Absolute G-XYZ and Attached to Moving Cylindrical Tube G-xyz)

Figure **2**. Forces and Torques Acting on Cylindrical Tube with Angle of Attack α

Figure **5**. Trajectory of Flow Line Through M Directly

Impacting Interior Cylinder Surface at P with Normal

Pressure Force Component at Angle i with MP. Impacted

Domain is Upper Limited by Half Ellipse AEB
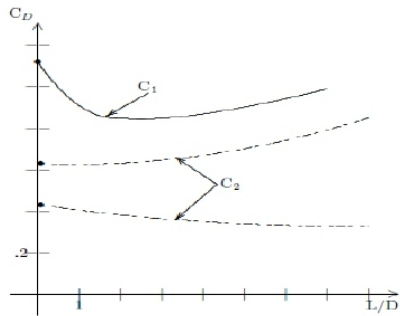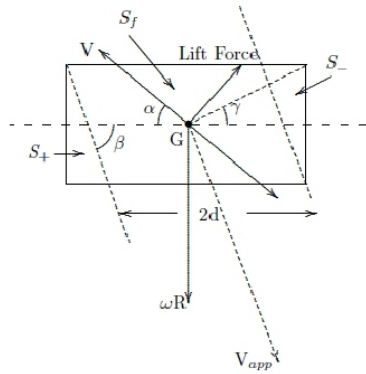
Figure **4**. Apparent Velocity V_{app} of Flow Lines
Figure **3**. Normalized Drift Coefficient C_D vs. Length/

Around Flying Cylinder in Domain S_f of Width 2d Diameter Ratio L/D for Tubular Wing Parallel to the

and Exterior (Convex) S_- and Interior (Concave) Flow (Curve C_1) and Perpendicular to it (Curve C_2).
S_+ Cylinder Surfaces Hit by Flow Lines C_1 Corresponds to Reynold Number $\mathcal{R}e > 10^3$, Upper

Curve C_2 to $\mathcal{R}e \cong 10^5$, Lower One to $\mathcal{R}e > 510^5$

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GENERAL VOCABULARY IN THAI EFL UNIVERSITY STUDENTS' WRITING: A CORPUS-BASED LEXICAL STUDY

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ABSTRACT - Default Paragraph Font;ปกติ1;This study questions the use of general vocabulary in Thai EFL University Students' Writing as a part of larger scale task investigating. General vocabulary represents the most frequent words of English, which are useful for English language learners. The corpus-based lexical study had two main purposes: a) to carry out a list of general words used frequently in writing as performed by Thai EFL university students, and b) to compare the word l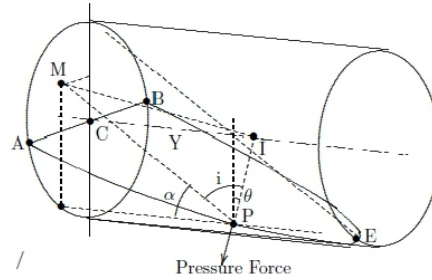ist with the New General Service List (NGSL) (Browne, C., Culligan, B. & Phillips, J., 2013) in order to settle their coverage in the Thai EFL University Students' Writing (TEFL Corpus). We compiled and investigated 1,233 writing tasks of Thai EFL university students comprising of 661,596 words. Our analysis acknowledged that, of 2,818 high frequency words in the NGSL, 1,648 appeared frequently in the corpus and the coverage accounted for 1.41% of the token in this corpus.

Keywords: Keywords:General Vocabulary, the New General Service List, Corpus-Based Lexical Study

1. INTRODUCTION

The significance of vocabulary in learning a second or foreign language is very important as claimed by many researches. (Schmitt, 2008, Schmitt and McCarthy, 1997 and Read, 2000).Knowledge of vocabulary is a primitive element in language learning as it could be determined the level of a foreign language learner (Al-Dersi, 2013). Clouston (2013) recommended thatvocabulary is fundamental awareness to English language teaching without adequate vocabulary students cannot comprehend others or express their own ideas. Thus, vocabulary is needed as an aspect of all the fours skill for communication (Harris, 1990). One important skill that concerns thevocabulary knowledge is writing as it is the ultimate skill for language learning. When learning a language, writing is an important skill to be accomplished as it acknowledges students find their own voices in their new language.It also allows them to communicate effectively in different contexts and with different audiences (Catramado, 2004). Yet, most of them cannot achieve this skill effectively. This is because writing is an advancing skill of discovering the practical words to write and share

thoughts and feelings. Some researchers claimed that the knowledge of vocabulary precisely affected on ESL or EFL learners' writing ability. As suggested by Bello(1997):

"Writing also enhances language acquisition as learners experiment with words, sentences, and larger chunks of writing to communicate their ideas effectively and to reinforce the grammar and vocabulary they are learning."

This idea is supported by Al-Dersi (2013) that foreign language learners need the mature vocabulary knowledge in academic lives. One of the problems in English learning is an adequate size of vocabularysince the greater range in teaching higher level involve the greater knowledge of vocabularyas recommended by Nation (2001). Thus, it is essential to teachers to select vocabulary fits the level of learners. Some theoretical and practical researches in EFL guide that general words should teach to EFL learners since it can be highly valuable for them (Kuno, 1999, Ito, 2000, and Saku, 2004).Since research into Thai university students' writing has been poor. This does not mean; however, that there

has been no research in this area. There are some linguistic analyses based on verb, liking adverbial, or connectors. However, there is insufficient attention to carry out a general word list. Consequently, the present study aims to examine the most frequently general word list in Thai university students' writing. The results obtained from this study may be developed further to be used as EFL materials for Thai students.

2. RESEARCH QUESTIONS

The current study examines the following question:

• What are the most frequently used general words in Thai EFL university students' writing (TEFL)Corpus?

2. DATA AND METHODOLOGY

3.1 THE CORPUS

The selected corpus of this study composed of 1,232 writing tasks written in English by 154 EFL students of Rajamangala University of Technology Isan (RMUTI) as a part of English Writing for Daily Life course which took over an academic year 2015. RMUTI students were asked for studying this course as a requisite subject of their Bachelor degree. Before attending this course,they have to pass two fundamental English courses in their first year. In this course, they were asked to write essay sets that had eight topics as follows:

Task A: Writing about yourself

Task B: Writing about your classmate/roommate

Task C: Writing about your family

Task D: Who I am

Task E: The Weaker Sex

Task F: The Shared Refrigerators

Task G: Reason not to own Hammer Car

Task H: The Smart Car

3.2 THE SOFTWARE FOR ANALYSIS

The concordancing software called "WordSmith Tool Version 6" (Scott, 2012) was selected for this study. This is an integrated suite of programs for looking at how words behave in texts. It was used to examine how words were used in any kind of texts. The Wordlist tool of concordancing software was used for making a word list of vocabulary. The characteristic capacity of wordlists serves the alphabetical and frequency order of the words and phrases (Scott, 1999). It can make a comparison between numbers of words or phrases then the results are completed by the selection and grading of the words and phrases as the sources of dictionaries or teaching materials. Aside from that, it provides to distinguish the category of vocabulary by calculating token (running words) and type (distinct words) (Scott, 2004).

3.3 PROCEDURE AND DATA COLLECTION

In order to investigate the frequency and range of general words, all writing tasks were typed in Microsoft Word Office 2010 due to all data were handwritings as the concordancing software "WordSmith Tool Version 6" cannot perform the handwriting analysis. In this study, the researchers comprised the normalization, segmentation, and standardization. These words were changed into their simple forms such as plural nouns were converted into singular and segmentation is originating word family forms. Then, frequent general words used in TEFLCorpus classified in order to create a list of general words and compared with the New General Service Wordlist (NGSL) for analyzing the differences between two corpora.

3.4 DATA ANALYSIS

The research question purposed to examine the frequency of general words that are used in TEFL Corpus. In order to answer this research question, the first step was to employ the Wordlist tool for making the word frequency lists of each task. The Wordlist tool offered both alphabetical and frequency order of the general words in the TEFL Corpus. Next, the

most frequently occurring GSL words were obtained. After that, the researchers picked the20 most frequently occurring general words in TEFL Corpus then compared with the NGSL (Browne, C., Culligan, B. & Phillips, J., 2013). The purpose of the comparison between general words in TEFL Corpus and the NGSL is to illustrate the differences of frequency and range of most frequently occurring words.

3   RESULTS

To study the frequency and distribution of general words, a corpus of 143,027 words from Thai EFL university students' writing has been applied. After analyzing the data, following results have been achieved that demonstrated below.

Table 1 General Statistics of Each Task

	Task A	Task B	Task C	Task D	Task E	Task F	Task G	Task H	Total
No. token	9,598	11,527	20,961	12,657	11,016	28,037	37,865	11,366	143,027
Types	49	598	84	729	635	2,788	3,389	2,970	11,242

According to Table 1, the tokens or running words of each task were 9,598 for task A, 11,257 for task B, 20,961 for task C, 12,657 for task D, 11,016 for task E, 28,037 for task F, 37,865 for task G, and 11,366 for task H. From the data, task G had the highest number of token words while task A had the smallest number of tokens. As for word types, task G also had the highest number of different word types (3,389) whereas task A had the smallest number of different word types (49). The six other tasks of TEFL Corpus were close to one another in terms of number of words types, namely 598, 84, 729, 635, 2,788, and 2,970 in task B, C, D, E, F, and H.

Table 2 The Top 30 Most Frequently Occurring General Words of TEFL Corpus

Rank	Word	F	%	Rank	Word	F	%
1	be	7,868	6.58	16	than	962	0.80
2	the	5,196	4.34	17	men	959	0.80
3	and	3,986	3.6	18	he	866	0.72
4	a	3,426	3.13	19	do	768	0.64
5	I	3,395	2.84	20	but	752	0.63
6	my	2,474	2.07	21	this	739	0.62
7	in	2,445	2.04	22	live	694	0.58
8	to	1,947	1.63	23	shelf	685	0.57
9	of	1,943	1.62	24	old	672	0.56
10	on	1,371	1.15	25	like	667	0.56
11	women	1,370	1.15	26	she	664	0.56
12	have	1,367	1.14	27	there	580	0.48
13	for	1,170	0.98	28	name	569	0.48
14	it	1,080	0.90	29	for	560	0.47
15	at	1,015	0.85	30	reason	552	0.46

Total of frequency of occurrences 50,741
Total of % of text coverage 42.95%

Table 2 provided the list of the top 30 most frequently occurring words of the TEFL Corpus. The total of frequency of occurrences in this table was calculated from

1st rank to 100th rank. There was a total of 50,523 occurrences that accounted for 42.76% of text coverage, of the whole corpus which was 100%. It was to be supposed that high frequency words in this corpus were article, pronouns, and the verb to be. In the list, the top five high frequency words were "be', "the", "and, "a", and "I". Also, the verb to be in the TEFL Corpus, "be" appeared 259 times, "am" 660 times, "is" 4,228 times, "are" 2,502 times, "been" 50 times, "was" 151 times, and "were" 18 times.

Table 3 The Comparison of 20 Most Frequently Occurring General Words of TEFL Corpus and the New General Service List (NGSL)

Rank	TEFL Corpus	Freq.	NGSL	Freq.
1	be	7,868	the	60,910
2	the	5,196	be	48,575
3	and	3,986	and	30,789
4	a	3,426	of	30,126
5	I	3,395	to	29,272
6	my	2,474	a	27,872
7	in	2,445	in	21,142
8	to	1,947	have	14,210
9	of	1,943	it	13,772
10	on	1,371	you	12,810
11	women	1,370	he	11,017
12	have	1,367	for	10,025
13	for	1,170	they	9,764
14	it	1,080	not	9,494
15	at	1,015	that	8,653
16	than	962	we	8,401
17	men	959	on	7,763
18	he	866	with	7,381
19	do	768	this	7,003
20	but	752	I	6,820

From the data shown in Table 3, the aim of the comparison between general words of the TEFL Corpus and the New General Service List (NGSL) is to present that general words in the TEFL Corpus were generally similar to the NGSL. It can be seen that there were 13 out of 20 words in TEFL Corpus matched with the NSGL; however, they were different inrankings. For example, the most frequent general word occurring in the TEFL Corpus was "be" with 7,868 occurrences whiles in the NGSL "be" was the 2nd rank appearing 48,575 times. Additionally, "the" in the NGSL was the 1st rank appeared 60,910 times in the NGSL whereas "the" was the 2ndrank occurring 5,196 times in the TEFL Corpus.

5. DISCUSSION

In order to answer this question, the concordancing software "WordSmith Tool Version 6" was used. It was used to view how words behave in texts and to create the word frequency lists of Thai EFL university students' writing by using the Wordlist Tool which provided both alphabetical and frequency order of the words in the text files. The entire corpus was 143,027 tokens or running words. According to the analysis of this study, the 30 most frequently occurring words of TEFL Corpus was obtained (Table1). It was found that high frequency in this corpus were article, pronoun, conjunction, and the verb to be. For instance, the top five high frequency words were "be", "the", "and", "a", and "I". After obtaining the top 30 most frequently occurring words, the top 20 most frequently occurring words were compared to the NGSL. It was revealed that the general words of TEFL Corpus were mostly similar to each other; however, there were different in rankings. The reason for this difference might be the limitation of this study such as the total number of tokens or running words.

Moreover, the general statistics of each task demonstrated the number of the different word types of the whole corpus to be 11,424 word types. According to the data (Table 1), task G had the highest number of tokens and the highest number of different word types than the other tasks, namely task A, B, C, D, E, F, and H respectively. This is because some word types of the other seven tasks may repeat in more than one task of writing tasks. In addition, task G had the highest number of tokens and the highest number of different word type as well since students tried to express their ideas and giving reasons covered by the topic. It can be explained that it may be a larger piece of writing for EFL students when they face with writing such arguing, discussing, or giving reason and opinion topic. This means they tried to use various words to explain or describe their opinions, ideas, or feelings more than other writing tasks. For these results, it is possible to improve EFL students/learners' writing by writing in practical situation, arguing, discussing, or giving reason and opinion.

6 CONCLUSION

The importance of vocabulary in foreign language learning in all subject disciplines as it is one of the understanding area in language (Cameron, 2001). This study aimed to show the general words list of Thai EFL university students' writing. For this aim, a corpus of 143,027 running words of 1,232 writing tasks which written by 154 EFL students of RMUTI was used. The researchers typed all tasks in the Microsoft Office Word 2010 as this concordancing software cannot carry out the handwritings analysis then used the concordancing software "WordSmith Tool Version 6" (Scott, 2012) in order to create a general word list of this study. As results in Table 1, 2, and 3 display, have a great number of the whole corpus. The findings exhibited that general words play an important role for EFL students used in their daily life.

The results of this study would be help teachers realize the significance of vocabulary in writing and useful for learners or course designers when they write material for teaching writing in EFL area. Besides, teachers could apply these results in order to develop their classroom teaching for grammar and vocabulary. Also, learners can adapt these results to comprehend and realize how English is used in daily life for achieving their ability to write. In addition, this study revealed that a corpus study and the usage of concordancing software could be a reasonable tool for developing resources as direction to writing material in EFL courses. Presently, it is easier for material writer or course designers to develop materials and serves beneficial resources than in the past with the availability of computers and concordacing software.

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ORIGIN AND EXPANSION OF ENGLISH IN INDIA AND MAJOR CHALLENGES AMONG MODERN TECHNICAL STUDENTS ABOUT SUSTAINABILITY OF IT

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ABSTRACT: The arrival of English Language in India is marked as a result of colonization. The British first arrived in India in the early of 1600s and soon after they began trading under the control of the East India Company. Lord Macaulay (1800-1859) a British Historian and Politician who served in India in 1834-38, played a major role in introducing English and western concepts to education in India. He supported the replacement of Persian by English as the official language, the use of English as the medium of instruction in all schools, and the training of English-speaking Indians as teachers. Till the most recent, English has acquired the reputation of being a language of emerging generation in India.

The present research paper throws light on how, despite of various pressure of nationalists in the country, English has become a widely spoken and understood second language in India and the basic challenges in learning English being faced by the modern students who hail from non-convent schooling and are pursuing Technical courses in various universities in the country. The article would be helpful to the students in learning English and through it achieving their goals. The paper also suggests the suitable remedies against these challenges by adopting certain scientific methods being introduced in the classroom transactions to draw fruitful conclusions. I have been teaching English to the Indian students for around 13 years. The paper would contain the details of the scientific methods being employed in the classrooms transactions with the positive conclusions with relevant case studies. I hope the paper would prove beneficial to the students feeling difficulties in learning English.

1. INTRODUCTION

While writing his essay entitled "The Gandhian Outlook", Dr. S. Radhakrishanan, the distinguished indo-anglian writer and the former president of India states "If Gandhiji had lived longer; he would have worked to build a world state". If the various countries of the world are to be seen as the part of that world state, it would not be an exaggeration to acknowledge English as the main language of this state. With the emergence of the concept of globalization, the world today, becoming more of a global village, English language has become a persuasive tool of socio-cultural and knowledge exchange. As a whole, English has acquired the reputation of being a major language of the globe today. In this paper, I have tried to explain the origin and development of English language in India and finally the major challenges of the modern technical students in the country who hail from the non-convent schooling and country background about sustainability of it along with the suitable remedies.

1   ENGLISH GETS THE OFFICIAL STATUS IN INDIA

India is a country located in southern Asia. With over 1.2 billion people, India is the most populous democracy in the world. It is a federal constitutional republic governed under a parliamentary system consisting of 29 states and 7 union territories. Every state has its own regional languages and these languages are totally different from the national language i.e. Hindi. India has been a land of diverse languages and hundreds of languages are spoken throughout the nation. According to the census 2001 "There are total 234 identifiable mother tongues which have returned 10,000 or more speakers each at the all-India level, comprising 93 mother tongues grouped under the Scheduled Languages (Part A) and 141 mother tongues grouped under the Non-Scheduled languages (Part B)". In British India, English was the sole language used for administrative purposes as well as for higher education purposes. When India became independent in 1947, the Indian legislators had a big challenge in choosing a language for official communication as well as for communication between different linguistic regions across India. The choices available were:

- Making "Hindi" the official language (41% of total population identified Hindi as their native language).

- Making English the official language (as preferred by non-Hindi speakers, particularly Kannadigas and Tamils, and those from Mizoram and Nagaland).

• Declare both Hindi and English as official languages and each state is given freedom to choose the official language of the state.

The Indian constitution, in 1950, declared Hindi in Devanagari script to be the official language of the union. Unless Parliament decided otherwise, the use of English for official purposes was to cease 15 years after the constitution came into effect, i.e. on 26 January 1965.The prospect of the changeover, however, led to much alarm in the non Hindi-speaking areas of India, especially in South India whose native tongues are not related to Hindi. As a result, Parliament enacted the Official Languages Act in 1963, which provided for the continued use of English for official purposes along with Hindi, even after 1965. Now, English is the co-official language of India, with more than 90 million speakers throughout the country. After Hindi it is the most commonly spoken language in India and probably the most read and written language in India.

3 ORIGIN AND DEVELOPMENT OF ENGLISH IN INDIA

The origin of English language in India is marked as a result of colonization. The British first arrived in India in the early of 1600s and soon after they began trading under the control of the East India Company. Lord Macaulay (1800-1859) a British Historian and Politician, who served in India in 1834-38, played a major role in introducing English and western concepts to education in India. He supported the replacement of Persian by English as the official language, the use of English as the medium of instruction in all schools, and the training of English-speaking Indians as teachers. Till the most recent, English has acquired the reputation of being a most popular language of emerging generation in India.

The details are found in Indian history that at the outset of their ruling in India, the British searched for Indian mediators who could help them to administer India. The British turned to high caste Indians to work for them. Many high caste Indians, especially the Brahmans worked for them. The British policy was to create an Indian class who should think like the British, or as it was said then in Britain "Indians in blood and colour but English in taste, in opinions and morals and intellect". The British also established in India universities based on British models with emphasis on English. These Indians also got their education in British universities. Raja Ram Mohan Rai (1772-1833), the great social reformer, has come to be called as the "Maker of the Modern India", was also in favour of the spread of English in India. His letter addressed to Lord Amherst (1773-1857) in the year of 1823 is often presented as evidence of local demand for English. Roy adopted to European learning, and according to him, English provided Indians with "the key to all knowledge – all the really useful knowledge which the world contains". In his letter, Roy expresses his opinion that the available funds should be used for employing European gentlemen of talent and education to instruct the natives of India in mathematics, natural philosophy, chemistry, anatomy and other useful sciences, which the natives of Europe have carried to a degree of perfection that has raised them above the inhabitants of other parts of the world.

 The English Christian missionaries came to India from 1813 and they also built schools at primary level for Indians in which the language of instruction was local language. Later on the missionaries built high schools with English as the language of instruction which obliged the Indians who wanted to study to have a good knowledge of English. The British rulers began building their universities in India from 1857. English became the first language in Indian education. The 'modern' leaders of that era in India also supported English language and claimed it to be the main key towards success. Indians who knew good English were seen as the new elite of India. Many new schools were established in which the language of instruction was English.

Just a few centuries ago, English was spoken by just five to seven million people on one, relatively small island, and the language consisted of dialects spoken by monolinguals. Today there are more non-native than native users of English, and English has become the linguistic key used for opening borders: it is a global medium with local identities and messages. English has become a world language, spoken by at least 800 million people. It is more widely spoken and written than any other language, even Latin, has ever been. It can, indeed, be said to be the first truly global language. English is nowadays the dominant or official language in over 60 countries.

4. MAJOR CHALLENGES AMONG MODERN TECHNICAL STUDENTS ABOUT SUSTAINABILITY OF ENGLISH LANGUAGE & SUITABLE REMEDIES

Today, there are more than a million English medium schools established throughout the country and they impart English education and a student of such school gets fluency in English language as soon as it reaches between 5th to 8th standard levels. Private English medium schools

are gaining popularity throughout India as urban upper middle class Indians who feel that English is the global language send their children to these schools. Increasingly, many poor families too are sending their children to English medium schools due to the poor quality of education in Government run vernacular medium schools. Along with their respective studies, the students are provided with ample opportunities to be fluent in English language. The results are very positive and they become expert not only in speaking but also in reading and writing effectively. The English spoken environment also helps them to enhance their listening skills.

But the case is different with the students who hail from rural background and non-convent schooling. The present research paper throws light on the basic challenges in learning English being faced by the modern students who hail from non-convent schooling and are pursuing technical courses in various universities in the country. Once they are devoid of acquiring fluency in English language up to the college level, it becomes a major challenge in their life to be fluent in it. Here, I have tried to explain the main causes of this complex problem and ultimately reached to some of the solutions that may prove beneficial to these students of the country and the students facing the similar problems throughout the globe.

The primary reason of the students about reading English is, no doubt, to get through the exams being conducted at the end of the year in every class. But ultimately, this knowledge has to be applied in their day-to-day life. In his preface to the book entitled "Contemporary English Grammar for Scholars and Students", JD Murthy says that the students read English grammar merely for "the Grammar's sake" implying that English grammar is learnt or taught as per to make students acquire marks in the exams. This may be considered as the primary reason. Language learning is a natural process for the natives. But for the students of other languages, deliberate efforts are required to learn a foreign language. The students of rural and semi-urban areas in India face problems as English is not their mother-tongue. For such students, respective problem centred methodologies are to be developed by the teachers. While speaking about methodology, Edward M. Anthony says that "method is an overall plan for the orderly presentation of language material no part of which contradicts and all of which is based upon, the selected approach". The orderly presentation of language to students is influenced by several factors. The teacher has to keep in mind the age of the student, his native language, his cultural background and his previous experience with

English. The goal of a course must be kept in mind by the teacher to achieve the desired effects – whether it is aimed at reading, fluency in speech, inculcating translation skills etc. All these objects shape methodology. The traditional method of teaching English seems faulty in itself. The method used in Hindi medium schools to teach grammar is very problematic. For example, while teaching tense study, instead of teaching the proper use of a particular tense, it is taught to the students that if a hindi sentence ends with "Ta Hai" or "Ti Hai", use the structure of simple present tense or similarly the sentences ending with "Rha Hai" or "Rhi Hai", the structure of present continuous tense is recommended and so on. Once, the student adapts to the wrong methods of implementing Grammar in his/her formative years, it becomes very difficult to make him/her understand the universal usages of grammar. The students get no idea of proper sentence structure. Learning a second language means acquiring a system of rules, but a very little is known about these rules and students find themselves unable to express in English. The students of rural areas do not realize the importance of English as a language of communication whereas this is the most important aspect of this global language. They lack the confidence to speak in English and their expression in the language is poor. First reason is that they have been taught English through Grammar-Translation Method. This method makes them dependent on their mother tongue. Whatever they read, they translate it into their own vernacular.

To solve all these issues, a systematic approach should be followed. The teacher should aim at teaching primarily, not knowledge but skill, the different skills required for good Listening-Speaking-Reading and Writing. Teachers should find some way of helping students to enjoy their language activities, and of building their confidence. Hesitation and low confidence in speaking English are the fruits of improper knowledge of grammatical rules. The English teacher should have the wide-ranging enthusiasm and imagination. It can make English course interesting to the students and they would be implying their learning in practical life. Secondly, to become fluent in the target language is somewhat a matter depends on the atmosphere building. The teacher, after working on the fundamental grammar, should change the Grammar translation method to the direct teaching method. Students should be given at least 5-10 minutes to speak in English on a given topic in the presence of the teacher with the complete English spoken atmosphere. Situational dialogues also play an important role in removing hesitation, to get fluency and

improving the student's pronunciation if it is tried by the students in the presence of the teacher.

For the better results of the English spoken classes, students should also be taken out to a public place or a park once a week where the teacher can organize various activities. When they would speak in public, it would greatly be effective to enhance their confidence level. To handle the problem of lack of vocabulary in the students, productive and receptive use of words should be kept in mind. The students should be made to learn simple words. They may be suggested to read daily English newspapers. This will help in inculcating a habit of learning new words in them. Their newly learnt words will become a part of their own vocabulary and they will be in a position to use those words. This is the natural process of movement at need from receptive to productive use of the words. This enhancement of vocabulary will result into better expression. The common errors made by the students in the different usages of the same word can be cured by this technique. Normally, the students can not differentiate between Noun and Verb, adjective or adverb. They should be clearly guided about the difference between the parts of speech by practice. They can be made aware of the different parts of a word - root, suffix, prefix and how they can change the total meaning of the word by adding suffix or prefix with the root word. After laying stress on their vocabulary, students should be guided towards reading habits. Reading is the core of language learning. Students can acquire the speed and skills for practical purposes. They should be guided to mark the idioms and how the use of idioms makes the expression better. While reading, the students would also mark the difference in similar looking phrasal verbs.

The another major problematic area is the literacy rate of the country. Literacy and level of education are basic indicators of the level of development achieved by a society. Spread of literacy is generally associated with important traits of modern civilization such as modernization, urbanization, industrialization, communication and commerce. Literacy forms an important input in overall development of individuals enabling them to comprehend their social, political and cultural environment better and respond to it appropriately. Higher levels of education and literacy lead to a greater awareness and also contributes in improvement of economic and social conditions. It acts as a catalyst for social upliftment enhancing the returns on investment made in almost every aspect of development effort, be it population control, health, hygiene, environmental degradation control, employment of weaker sections of the society. Though, according to the census 2011, Indian literacy rate has grown to 74.04% from 12% at the end of British rule in 1947. Although this was a greater than six fold improvement in literacy rate but the level is still below the world average literacy rate of 84%. The most shocking fact is that of all the nations, India currently has the largest illiterate population. The following table shows the comparative status of literacy rate of the country:

Country	Literacy rate	Male	Female	Year
India	74.04	82.14	65.46	2011

To tackle the problem of illiteracy and to eradicate illiteracy in India, the efforts of Indian Government, all the state governments, NGOs and reformers are praiseworthy. Along with the implementation of Policy on Education in India, various schemes like NLM (National Literary Mission), SSA (Serva Shiksha Abhiyan), Adult Literary Programme etc are being implemented by the Government effectively to achieve 100% literacy in the country. The results are very positive. The Right of Children to Free and Compulsory Education (RTE) Act 2009 now ensures Right of children to free and compulsory education till completion of elementary education in a neighbourhood school in the Country.

5. CONCLUSION

As the literacy rate is growing up day-by-day in the country, the number of English speaking people is growing higher. English symbolizes in Indian minds, better education, better culture and higher intellect. In present times, English is the most preferred language. Indian accent is sometimes difficult for non-Indians to understand. Actually English has co-existed in the Indian sub-continent alongside thousands of local languages. It has remained at the heart of the Indian society. According to recent surveys, approximately 90 million people use English. It means India is the largest English speaking community outside USA and the UK. As India celebrates its 67th year of independence from British rule, English continues to expand its empire. I hope that the coming generation from non-convent schooling and rural background would recognize the value of the language and they would attempt meaningfully to be perfect in this global language.

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DATA MINING AND DATA WAREHOUSING FOR ANY EDUCATION SYSTEM

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ABSTRACT: Data-driven decision support systems, such as data warehouses can serve the requirement of extraction of information from more than one subject area. Data warehouses standardize the data across the organization so as to have a single view of information. Data warehouses can provide the information required by the decision makers. Developing a data warehouse for educational institute is the less focused area since educational institutes are non-profit and service oriented organizations. In present day scenario where education has been privatized and cut throat competition is prevailing, institutes needs to be more organized and need to take better decisions. Institute's enrollments are increasing as a result of increase in the number of branches and intake. Now a day, any reputed Institute's enrollments count in to thousands. In view of these factors the challenges for the management are meeting the diverse needs of students and facing increased complexity in academic processes. The complexity of these challenges requires continual improvements in operational strategies based on accurate, timely and consistent information. The cost of building a data warehouse is expensive for any educational institution as it requires data warehouse tools for building data warehouse and extracting data using data mining tools from data warehouse. The present study provides an option to build data warehouse and extract useful information using data warehousing and data mining open source tools. In this paper we have explored the need of data warehouse / business intelligence for an educational institute, the operational data of an educational institution has been used for experimentation. The study may help decision makers of educational institutes across the globe for better decisions.

I. INTRODUCTION

Now a day, the educational institutes have to generate funds for their research and other operational activities as the government funding has been limited to aided institutes. Utilizing a decision support system is a proactive way to use data to manage, operate, and evaluate educational institute in a better way. Depending on the quality and availability of the underlying data, such a system could address a wide range of problems by distilling data from any combination of education records maintenance system. The data mining from data warehouse can be a ready and effective system for the decision makers. A data warehouse is a subject oriented integrated, non-volatile, and time variant collection of data in support of management decisions [1].Data warehouse obtains the data from a number of operational data base systems which can be based on RDBMS/ERP package, etc. The data from these sources are converted into a form suitable for data warehouse. This process is called Extraction, Transformation and Loading (ETL). In addition to the target database, there will be another database to store the metadata, called the metadata repository. This data base contains data about data-description of source data, target data and how the source data has been modified into target data. The client software will be used to generate reports.

II. MOTIVATION

Motivation for building data warehouse for the educational institute is from two sources, internal sources like inability of current operational systems to provide required information for parameter driven analysis and external sources like competitive factors. A survey is carried out by visiting several educational institutes to gather information regarding the current practices the institutes have implemented as decision support systems. The findings are summarized below.

A   The data is stored in different sources in distributed locations.

B   Users find difficulty in locating the reports needed by them.

C   The user interface for the current operational system is not satisfactory and is confusing and hard to use for decision makers.

D   When the consolidated report from two or more different subject area is required, it is almost impossible.

E   There is no easy way to get assistance.

Utilizing a decision support system is a proactive way to use data to manage, operate, and evaluate educational institute in a better way. Depending on the quality and availability of the underlying data, such a system could address a wide range of problems by distilling data from any combination of education records maintenance system. The purpose of this paper is to investigate current system of information delivery and propose a better system for timely, accurate, consistent information delivery to the decision makers of the educational institutes [2]

III. LITERATURE REVIEW
Following section briefly describes the different application areas for which data warehouses are built.

A. Retail Sales

Data is collected at several interesting places in a grocery store. Some of the most useful data is collected at the cash registers as customers purchase products. Modern grocery store scans the bar codes directly into the point of sale system. The POS system is at the front door of the grocery store where consumer takeaway is measured. The back door, where vendors make deliveries, is another interesting data collection point [8].At the grocery store, management is concerned with logistics of ordering, stocking, and selling products while maximizing profit. Some of the most significant management decisions are on pricing and promotions. Both store management and marketing spend a great deal of time tinkering with pricing and promotions. In such scenarios, data warehouses come to rescue.

B. Telecommunications

A telecommunications company generates hundreds of millions of call-detail transactions in a year. For promoting proper products and services, the company needs to analyze these detailed transactions. The data warehouse for the company has to store data at the lowest level of detail.

C. Transportation

In this case, the airline's marketing department wants to analyze the flight activity of each member of its frequent flyer program. The department is interested in seeing which flights the company's frequent flyers take, which planes they fly, what fare basis they pay, how often they upgrade, how they earn. These requirements can be fulfilled by data warehouse.

D. Education

There are some efforts in the area of data warehouse for building data warehouse for education domain. The paper by Carlo DELL'AQUILA [10] summarizes the experience in designing and modeling an academic data warehouse. Existing facilities and databases affect the chosen data warehouse that brings them together to support decisional activities leading the whole university environment, including administrators, faculties and students. The choice to develop a dedicated system is mainly forced by the peculiar information type that defines the basic information in data warehouse widely different from institution to institution .In the article titled 'What academia can gain from building a data warehouse' by David Wierschem, et.al [11].The authors have identified the opportunities associated with developing a data warehouse in an academic environment. They begin by explaining what a data warehouse is and what its informational contents may include, relative to the academic environment. Next they addressed the current environment drivers that provide the opportunities for taking advantage of a data warehouse and some of the obstacles inhibiting the development of an academic data warehouse. Finally, the article provides strategies to justify developing a data warehouse for an academic institution.

IV. DATAWAREHOUSE ENVIRONMENT

Utilizing a decision support system is a proactive way to use data to manage, operate, and evaluate educational institute in a better way. Depending on the quality and availability of the   underlying data, such a system could address a wide range of problems by distilling data from any combination of education records maintenance system. The data mining from data warehouse can be a ready and effective system for the decision makers. The data from reputed engineering college namely R V College of Engineering, Bangalore, Karnataka, India, has been considered for this study. Fig. 1 shows the data warehouse architecture of RV College where source systems are smart campus, asset management server and csv files, the information is spread across diverse platforms, data from different sources is collected and then consolidated to produce required report. ETL activities are performed to extract the data from heterogeneous sources and load into staging and then load the data into dimension and fact tables as per the schedules. We proceed to extract the BI report from data warehouse on demand based on requirement from the management. In an educational

institute, main information required will be regarding key components of the education institute, namely students, employees and infrastructure. The purpose of this paper was to investigate current system of information delivery and proposing a better system for timely, accurate, consistent information delivery to the decision makers of the educational institute. The paper has been prepared in order to extend the usage of current available technology in decision making processes of educational institute.
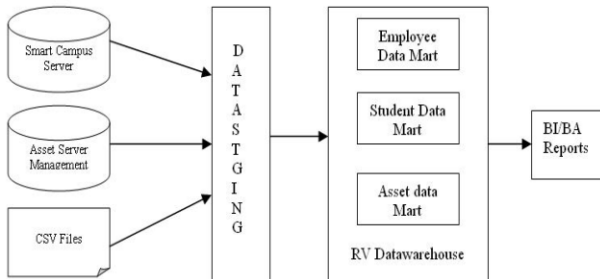

Fig. 1. Engg_Data warehouse architecture

Data warehouse enables the decision makers with benefits listed below.
1) Phenomenal improvements in turnaround time for data access and reporting
2) Standardizing data across the organization so that there will be one view of information.
3) Merging data from various source systems to create a more comprehensive information source.
4) Reduction in costs to create and distribute information and reports.
5) Encouraging and improving fact-based decision making.

V. BI-REPORTING

This refers to the variety of capabilities that can be provided to the users to leverage the presentation area for analytic decision making. All data access tools query the data in the data warehouse presentation area. A data access tool can be as simple as an ad hoc query tool or as complex as sophisticated data mining application. The majority of the users use pre-built parameter driven analytic applications to access the data. This enables them to retrieve the required information and analyze hidden pattern in the retrieved data [11].Using suitable data mining techniques, the useful information can be extracted from the data warehouse. Data mining form three main components of the institute, namely Employees, Students and Infrastructure. Employee data mart can provide the users with the information such as career growth and

attrition rate. Student mart can provide the information related to the student like best outgoing student considering his academic and non academic activities. Information regarding assets such as the investment in a particular financial year can also be accessed.

VI. RESULTS

Once the data warehouse is deployed, it invariably becomes a mission-critical application. Users depend on the data warehouse to provide them with the information they need to function properly. To make certain that the ETL process runs and completes, it must be actively monitored and supported. Some of the results observed after querying the data marts are documented below. The results are cross checked with the requirements specified by the different types of users. The requirements with regard to asset information were to extract the information regarding the number of assets of each type in the Institute. The different data marts are queried using SQL query. The results returned by the queries are found accurate and meeting users demands. The sample screen shots of queries and the results are shown.
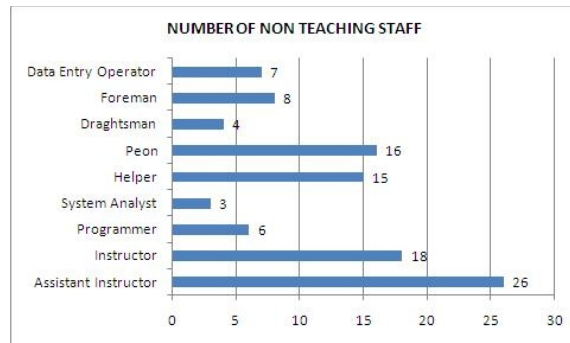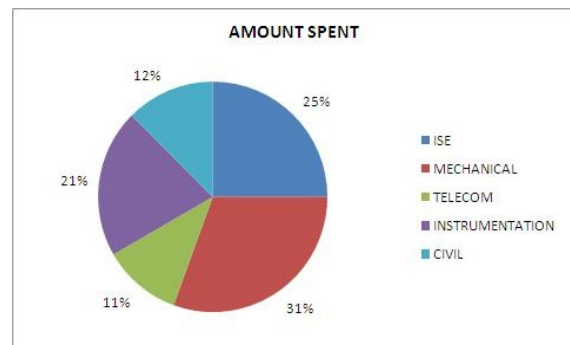

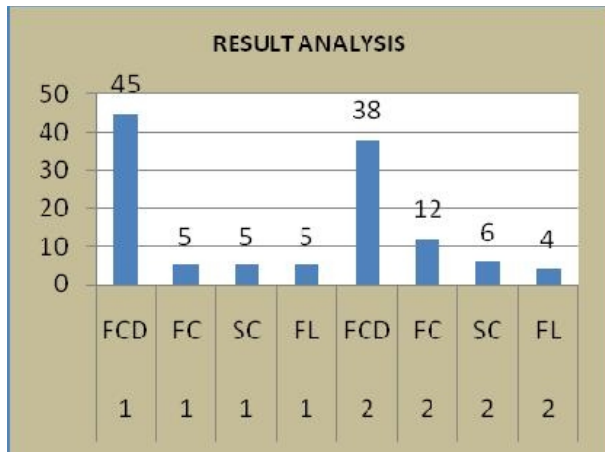**Fig. 2. Assets Information**

Fig. 3. Amount

Fig. 4. Result Analysis

Fig. 4 shows the detailed result analysis which shows number of students who have obtained different classes; this is the output from student mart.
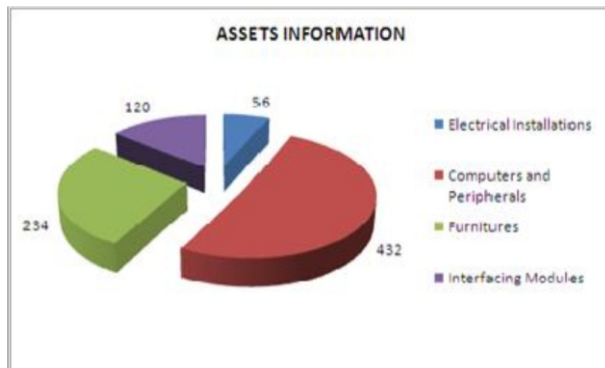

Fig. 5. Staff details

Fig. 5 gives the information regarding was the number of employees in each cadre of two particular departments. This is the output from employee mart.

VII. CONCLUSION

Justifying a data warehouse project can be very difficult. Usually, analysis of the success of the data warehouse project is done considering the financial benefits against the investment. Since most of the educational institutes are nonprofit organizations and service oriented, the evaluation of the usefulness of the data warehouse can be done on the basis of its ability to meet user's requirements. The academic data which was spread all across different sources has been loaded into single platform. The decision makers can extract information regarding three main components of the institute, namely Employees, Students and Infrastructure. Employee data mart can provide the users with the information such as career growth and attrition rate. Student mart can provide the information related to the student like best outgoing student considering his academic and nonacademic activities. Information regarding assets such as the investment in a particular financial year can also be accessed. In educational institute, decision makers ask "What are the expected results and benefits?" when making a data warehouse project rather than "What is the anticipated return on investment?". The data warehouse developed has met their expectations. Benefits of the present project can be more if the Institute has positive approach towards new technologies. They can take micro-level decisions in a timely manner without the need to depend on their IT staff. They can perform extensive analysis of stored data to provide answers to the exhaustive queries to the administration cadre. This helps them to formulate strategies and policies for employees and students. This helps students and Employees in making decisions. They are the ultimate beneficiaries of the new policies formulated by the decision makers and policy planner's extensive analysis on student and employee related data.

Over all 80 to 85% of decisions are made based on the reports generated by the proposed system. The realistic productivity is about 85%.

VIII. FUTURE SCOPE

The enhancement that can be carried out on the present system is the implementation of the real time ETL system. Real time ETL refers to the software that moves data synchronously into a data warehouse with some urgency-within minutes of the execution of the business transaction. Implementation of real-time data warehouse reflects a new generation of hardware, software and techniques. Capture, Transform, and Flow (CTF) is a relatively new category of data integration tools designed to simplify the movement of real-time data across heterogeneous database technologies. The transformation functionality of CTF tools is typically basic in comparison with today's mature ETL tools, so often real time data warehouse CTF solutions involve moving data from the operational environment, lightly transforming it using the CTF tool and then staging it.

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MUNICIPAL SOLID WASTE MANAGEMENT CASE STUDIES IN INDIA: A REVIEW

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ABSTRACT: Municipal solid waste management (MSWM) is one of the major challenges in Indian cities. The problem of solid waste management in India is failing day by day due to population growth, avoiding legal environment as well as unplanned and haphazard development of new and old cities. Improper management of municipal solid waste (MSW) causes outbreak of new diseases to inhabitants. A number of studies have been conducted in various parts of India to analyze the existing solid waste management (SWM) practices and to suggest better techniques for proper solid waste management. In this review, our aim is to find out the best SWM practice on the basis of different studies carried out by researchers in different parts of India.

Keywords: Municipal solid waste management, India scenario, SWM practices.

1. INTRODUCTION

Municipal Solid Waste Management (MSWM) refers to a systematic process that comprises of waste segregation and storage at source, primary collection, secondary storage, transportation, secondary segregation, resource recovery, processing, treatment, and final disposal of solid waste [1, 2]. The problem of solid waste management in India, in combination with rapid urbanization, population growth and unplanned development is worsening day by day. The more serious situation in future may arise due to the toxicity and unavailability of dumping grounds for such wastes.

According to United Nations Development Program survey of 151 major cities from around the world, the second most serious problem that city dwellers face (after unemployment) is insufficient solid waste disposal [3]. Solid waste management has always been a serious problem for cities throughout the world. It is not different in developing countries like India. In certain regions of our country, the free disposal facilities have reached their own capacity and even local governments are confronted with difficult decisions [4].

Solid waste should be handled and disposed off properly or else it poses numerous risks. To reduce the effects of waste on human health and environment, solid waste management should be undertaken [5]. There is a need to work towards a sustainable waste management system, which requires environmental, institutional, financial, economic and social sustainability [6]. Due to a lack of serious efforts by town/city authorities, the management of garbage has become a tenacious problem, notwithstanding the fact that the largest part of any municipal expenditure is allotted to it [7]. Urban Solid Waste Management (USWM) in developing countries comprises both formal and informal systems. The formal system consists of two bodies: (i) the municipal body and (ii) private organizations. The informal system consists of many such as waste-pickers (rag-pickers), itinerant buyers, small scrap dealers, and wholesalers, who, together, recycle about 20% of the waste. Householders also contribute to informal recycling by indulging in source separation in a limited way [8].

The management of MSW had been going through a critical phase, due to the unavailability of suitable facilities to treat and dispose off the larger amount of MSW generated daily in metropolitan cities. Unscientific disposal causes an adverse impact on all components of the environment and human health [9]. With the urban population in India growing at 2.7 per cent to 3.5 per cent per annum, the yearly increase in the overall quantity of solid waste in the cities will be more than 5 per cent [10].

India has achieved multifaceted socio-economic progress during the last 67 years of its independence. However, in spite of heavy expenditure by the civic bodies, the present level of service in many urban areas were not adequate therefore it is a threat to the public health in particular and the environmental quality in general [11].

2. STUDIES ON MSWM IN INDIA

A number of studies have been conducted all over India on municipal solid waste management. Researchers have tried to find out the different practices of solid waste management followed in the places of study. They have

also compared it with the standard practices as per Municipal Solid Waste Management and Handling Rules 2000 to find out whether the practice is satisfactory or not. Some of the case studies conducted in different Indian states are summarized below alphabetically in ascending order:

2.1 ANDHRA PRADESH

2.1.1 Eluru: In this study, household surveys were done in six divisions of Eluru Municipal Corporation, A.P. It was estimated that 59 – 65 tons of wet waste is generated in Eluru per day and if this wet waste is converted to quality compost 12.30 tons of vermi compost could be generated. If Municipal Corporation of Eluru (MCE) manages this wet waste an income of over rupees 0.89 crores per annum could be earned by MCE which is a considerable amount for providing of better services to public. The study concluded that the municipal corporations had not been very effective as far as MSW services are concerned [12].

2.1.2 Tirupati: Status of solid waste management (SWM) in Sri Venkateswara University College of Engineering Hostels in Tirupati was presented in this paper. Quantity, physical components and chemical characteristics of solid waste and disposal practices were detailed. Further, energy content of waste from boys and girls hostels was found out and it was concluded that slightly higher energy content offers potential for energy recovery from hostels solid waste. The per capita solid waste generation was estimated as 0.28Kg/person/day (in boys hostel) and 0.312Kg/person/day (in girls hostel) respectively. From the study it was concluded that solid waste management was not satisfactory and deserved improvement [13].

2.2 ASSAM

2.2.1 Guwahati: In this study, the most polluted area in Guwahati city had been studied from the point of municipal solid waste. The most affected aquifer zones were identified through GIS applications. As per the study, the average waste generation in Guwahati city was 2.66 kg per day per household and the per capita waste generation was 606 gram per day. The biomedical waste finds its way into the municipal solid waste to some extent in Guwahati. The other industrial wastes and carcasses were also not disposed in proper manner. The wastes were disposed in the West Boragaon dumpsite without any processing, causing health risk to the local people and resulted in pollution of the land, air and water. Measures to reduce the problem have to be taken in the best possible way to keep the Guwahati city as a clean and healthy place for its citizens [14].

2.3 CHANDIGARH

The study aimed at providing an overview of the existing solid waste management practices in Chandigarh and suggested solutions to some of the major problems being faced by the existing system. An average of 370 tons/day of solid waste is generated in Chandigarh municipal corporation area. The collection efficiency was about 70% from registered households and 20% from the slums and surrounding villages. Certain deficiencies included lack of suitable trained manpower, inappropriate collection routes and often unavailability of collection vehicles. Further, insufficient number of bins and bin capacity at different locations often led to overflow of waste. A public private partnership had been implemented for producing refuse derived fuel from solid waste which reduced some load on the designated landfill site. The landfill site is unsanitary, lacking proper lining system which led to percolation of leachate thereby contaminating groundwater sources in and around Chandigarh city [15].

2.4 DELHI

2.4.1 Delhi: In this study, recycling of the municipal solid waste (MSW) was investigated and analyzed in the Indian capital city of Delhi. It was found that an informal sector comprising waste recyclists and a hierarchy of recyclable dealers play an important role in the management of solid waste. The associated activity transports nearly 17% of the waste to the recycling units (RU). Two models were proposed to evaluate the possibility of formalizing the unorganized waste trade. It was concluded that it is possible to organize the sector, but this would leave more than 66,000 recyclists without employment, a consequence of organizing an activity that presently provides employment and daily living to nearly 89,600 recyclists who belong to the poorest strata of the society [16].

2.4.2 Ghazipur: In a study conducted in Ghazipur, status of the municipal solid waste (MSW) of Ghazipur city was studied. The results indicated that the organic waste was the highest among other components of the wastes. A considerable proportion of organic carbon was found which causes the health problem to the workers. The average quantity of solid waste generated in Ghazipur city was 205 g/capita/day, the daily disposal of the refuse was approx. 15-16 tons in year 2004. This paper was an effort to present the segregated estimation of the different wastes, to highlight its resource recovery and disposal recommendation prospects [17]. The decomposition of organic components produces methane, a significant

contributor to global warming. Based on the waste composition and the amount of total MSW dumped, a first order decay model (FOD) was applied to estimate the methane generation potential of Ghazipur landfill site, which yielded a maximum value of 15.3 Gg per year. This value accounts about 1-3 % of the Indian landfill methane emission [18].

2.5 HARYANA

2.5.1 Kurukshetra: A study was taken to find out the problems of solid waste in Kurukshetra district. The study tried to show the household behavior of Kurukshetra residents towards solid waste management and focused on the household's attitudes, perception and knowledge of solid waste management in Kurukshetra district (Haryana). A survey was administered to 100 households selected randomly from Kurukshetra district. To attain the objective of the study, use of statistical techniques such as means and standard deviation were done. The results indicated that, although the public is aware of solid waste management concept, yet the desired results are to be achieved. The results also indicated that participation in solid waste depends on the awareness level, household income, educational level and gender [19].

2.6 HIMACHAL PRADESH

2.6.1 Shimla: In this study an attempt had been made to assess the existing solid waste management system, environmental concerns, and the future interventions with respect to environmental and social well-being. Successful implementation of the door to door garbage collection in challenging terrains, optimized route planning, scientific treatment and disposal of inert on regional landfill model in Shimla city was documented. The daily waste generation in Shimla City was approximately 93.0 MT (350gm /capita/day). The collection of the waste through door to door collection and community bins was approximately 70-75 MT. Shimla Environment, Heritage Conservation and Beautification (SEHB) Society is responsible for the door to door collection from households. As per Municipal Corporation Shimla (MCS) record, 86 % of the residential population is covered under door to door waste collection system, followed by 14% population dependent on the community bins for waste disposal. The ward level routing and loading plan had been developed by MC Shimla with help of GIS. The collection vehicles run on a predefined and optimized route. Rejects from the processing unit and other non-biodegradable waste are currently being landfilled in a valley near the compost plant at Darni ka Bagicha [20].

2.7 JAMMU AND KASHMIR

2.7.1 Srinagar: This study highlighted operational system and core challenges related to the SWM in Srinagar city. Lethal environmental impacts and other related issues due to improper management of solid waste were also systematically examined. The remote sensing data of 2008(Resource sat) and top sheet of survey of India were used for the present study. There was only one dump site located at Achan in the North of the city. The amount of waste generated in Srinagar City was 370 metric tons/Daily and only 250 metric tons of Solid Waste is being collected by Srinagar Municipal Corporation. The location of existing dumpsite is in the middle of settlement and water body. The present method of operation of the sanitary landfill is also very crude and unscientific. Due to lack of funding and unscientific management the existing solid waste management system is not working successfully in the city. GIS technique can be employed for designing a long term planning for sustainable environmental management for urban centers of fragile Himalayas [21].

2.8 KARNATAKA

2.8.1 Mysore: The study was taken to find out the problems and prospects of Municipal solid waste in Mysore city. A detailed investigation was made regarding the methods of practices associated with sources, quantity generated, collection, transportation, storage, treatment and disposal of Municipal solid waste in Mysore city. According to MCC, around 259.14 TPD solid wastes are generated every day(0.35 Kg per capita per day). Out of 65 wards, MCC is responsible for transportation of about 50-55 % of solid waste generated, while private contractor are responsible for the rest 40-45 % of the waste in the city. Considering quantity and composition of Municipal solid waste generation in Mysore city, a composting plant was set up at Vidayranya Puram to generate compost from the city refuse. The remaining waste is being dumped besides the Excel plant. The city doesn't have disposal sites. There is also a small vermin-composting operational in Mysore Zoo. This study revealed that the present system of MSWM in Mysore city is not satisfactory based on Municipal Solid Waste (Management & Handling) Rules 2000 [22].

2.9 KERALA

2.9.1 Arpukara: In this study SWM of Arpukara Grama Panchayat of Kottayam district was taken into consideration. The study conducted here proposed, to

examine the quality and quantity of the solid waste generated in the panchayat and also its impact on the existing social, economic, environmental and ecological systems. On the basis of the survey, one could identify the stake holders, evaluate their attitude, understand their concerns, probe reasons for conflicts and consolidate the suggestions offered to improve the situation. The daily average generation of solid waste here is estimated as 5-6 tons. About 60 percent of the total waste generated was organic substances, suitable for composting. The wastes were dumped in the open and these wastes accumulated into huge heap, provided room for rodents to multiply, led to fly breeding and also foul smell, which caused severe environmental pollution [23].

2.10 MADHYA PRADESH

2.10.1 Shivpuri: In this study, MSWM environmental audit had been carried out for Shivpuri town of Madhya Pradesh, India through the collection of municipal solid waste, and interviews with stakeholders and field surveys. In the study, an attempt had been made to record the solid waste generated in Shivpuri town and the treatment given by people and the municipality. At present town's solid waste is collected and disposed by Shivpuri municipality. The total waste generated was estimated to be 34.284 quintals per day. There was no integrated solid waste collection, storage, transportation, treatment or disposal system in the town. Solid waste generated from households was being dumped in open areas. It was concluded from the study that the present solid waste management practices in Shivpuri town were highly unsatisfactory [11].

2.11 MAHARASHTRA

2.11.1 Mumbai: A study conducted in 2006 explored alternative approaches to municipal solid waste (MSW) management and estimated the cost of waste management in Mumbai, India. Two alternatives considered in the paper were community participation and public private partnership in waste management. Mathematical models were used to estimate the cost per ton of waste management. It was found that community participation in waste management is the least cost option and there is a strong case for comprehensively involving community participation in waste management [5]. In another study done in 2003, a comprehensive cost-benefit analysis for the present system of municipal solid waste management in Mumbai was carried out, with due consideration for implicit or hidden costs and benefits. Accounting for the

implicit costs and benefits showed a difference of $6 per every ton of waste disposal. With the increasing demand for improved waste management, private sector participation is essential and a Pigouvian tax is a necessary tool to make the private sector participation in solid waste management a success [24].

2.11.2 Pune: This paper described the present scenario of the SWM practices carried out in the Pune City. It also described the solid waste collection, transportation, treatment and disposal methodology adopted in Pune city. By the study, it was observed that Pune city is generating around 1100 metric tons of solid waste per day, which is collected, transported and disposed at a sanitary landfill site at Devachi Urali. Before sending entire waste to disposal site at Devachi Urali, the entire waste is send to transfer stations for weighing, and a computerized record is maintained. Pune Municipal Corporation (PMC) is playing a positive role in door-to-door collection of waste and could achieve in making container free areas. PMC has adopted the system of public awareness and active participation in reduction and disposal of solid waste. It was concluded that the composition of MSW showed mostly organic matter, so composting is a good method for treatment. The rapid increase in the quantities of MSW and the inability to provide daily collection services may cause a nuisance and health hazard. In PMC area such situation rarely arises because of efficient and scientific MSW practices implemented. The decentralized biogas plants based on solid waste will be the ideal solution. It will also generate the electricity, which will be the additional advantage [25].

2.12 ODISHA

2.12.1 Puri: The basic purpose behind this study was to find out the environmental crisis which was taking place in Puri urban region. The main objective of this study was to establish the status of existing system of waste generation, collection, transportation, recycling and disposal. The study was conducted to identify the sources of solid waste generation in the Puri town, to find out the environmental crisis, to analyze the spatio-temporal frameworks of solid waste generation, collection, and disposal and to access the processes and practices being used for the collection and disposal of solid waste generated in the town. It was concluded from the study that Puri town is currently facing the municipal solid waste dilemma, for which all elements of the society are responsible. Here in this town, community sensitization and public awareness is very low. There is no proper system of segregation of organic,

inorganic and recyclable waste at the household level. Public awareness and adequate budget should be made for SWM in Puri town [26].

2.13 RAJASTHAN

2.13.1 Jaipur: The study was taken to find out the problems and prospects of solid waste in MNIT Campus, Jaipur. A detailed investigation was made regarding the methods of practices associated with sources, quantity generated, collection, transportation, storage, treatment and disposal of solid waste in MNIT Campus. The solid waste collected from the bins were carried outside the campus at a particular dumping site or they dump the waste collected in the lower region of campus for filling this lower region to take it in level. Waste generation rates worked out to be 0.40 Kg per capita per day. From the study it was concluded that the solid waste management in MNIT appeared to be inadequate and needs up gradation. The solid waste has to be disposed of scientifically through sanitary landfill and recyclable portion of the waste should be salvaged [27].

2.14 TRIPURA

2.14.1 Agartala: A study was conducted on solid waste management in Agartala city of Tripura by the Agartala Municipal Council. New initiatives taken by council for SWM were also given in the study. The present challenges & problems faced were also detailed in this study report. As per the study, the total solid waste generation was 250 MT/ day in the city of Agartala. Primary Collection of Municipal Solid Waste under Agartala Municipal Council (AMC) includes 'house to house' or 'door to door' collection, collection of waste from commercial units like shops, hotels and restaurants. All the vehicles of mechanical wing are installed with GPS enabled vehicle tracking system. At present all the garbage collected from the city is disposed in two open dumpyards by way of landfill without proper processing. There is some facility for processing of garbage at Devendra Chandra Nagar Dump yard but it is not so scientific and sufficient. Hence most of the garbage is dumped without processing. New initiatives are being taken up and are planned to be implemented in near future as per the guidelines mentioned in the SWM Toolkit (JNNURM) [28].

2.15 UTTAR PRADESH

2.15.1 Allahabad: The objectives of the study were to determine the quantitative and qualitative characteristics of MSW along with basic information and to create GIS maps for Allahabad city. The samples had been randomly collected from various locations and analyzed to determine the characteristics of MSW. A questionnaire survey had been carried out to collect data from inhabitants including MSW quantity, collection frequency, satisfaction level, etc. The Geographic Information System (GIS) had been used to analyze existing maps and data, to digitize the existing sanitary ward boundaries and to enter the data about the wards and disposal sites. The total quantity of MSW had been reported as 500 ton/day, and the average generation rate of MSW had been estimated as 0.39 kg/capita/day. The generated ArcGIS maps gave efficient information concerning static and dynamic parameters of the municipal solid waste management (MSWM) problem such as the generation rate of MSW in different wards, collection point locations, MSW transport means and their routes, and the number of disposal sites and their attributes [29].

2.15.2 Varanasi: The study aimed to characterize the waste generated at four different places in Varanasi and evaluation and recommendations were made on data collected in order to improve the current SWM system of Varanasi City. Characterization of municipal solid waste showed Varanasi waste comprised maximum food waste (31.9 %) followed by plastic (22%), textile (10.6%), paper (9.6%), glass (6.7%), cardboard (6.2%), ash (5.3%), leather (5.7%) and minimum metals waste (2.8). Surveys showed that per capita MSW waste generation rate is 800 MT per day, 0.217kg/person/day. Sample from Ordalibazar showed the highest amount of energy content according to Modified Dulong Formula with a value of 254524.46 kJ/kg followed by Daphi 167545.84 kJ/kg, Nakhighat 96455.80 kJ/kg, Puranapull 16147.11 kJ/kg. Ordalibazar site have highest energy capacity compared to other sites and we can obtained more methane from NakiGhat site. The study also concluded that solid waste management and recycling is a major issue of Varanasi district [30].

2.16 WEST BENGAL

2.16.1 Kolkata: The purpose of this study was to outline the major trends and challenges that would shape the future of waste management for the next few decades in major metropolitan cities like Kolkata. Amounts of waste generation were largely determined by two factors: first, the rate of population increasing in Kolkata metropolitan area and second, its per capita waste generation - which are controlled by the evolution of economic growth, life style and food habits. The present study explained the

correlation analysis of different factors of municipal solid waste generation and the objective was to assess the future municipal solid waste stream in Kolkata metropolitan area. The results showed that for a decoupling to take place between economic growth and waste generation, the waste generation by firms and households in relation to their economic activities must decrease in the future [31].

2.16.2 West Bengal: Recently our Central Government has taken a national level campaign which is named "Swachh Bharat Abhiyaan". The present study had special focus on their initiatives. Present study had been carried out in Panchayat area, Municipal area and Paper mill and Institution. The areas covered in the study were – (i) Barrackpore Municipality, North 24 Parganas, (ii)Nokari Panchayat, under Ranaghat II subdivision,Nadia, (iii)Rudrapur Paper mill, Icchapur-Nilganj Panchayat under Barasat I block, North 24 Parganas and (iv)Vivekananda Institute of Bio-Technology, South 24 Parganas. The main purpose to select four different areas was to record a variety of solid waste management practices in these areas and at the same time their effect towards the surrounding environment. It was observed that in Purnanagar village under Nokari Gram Panchayat organic fertilizer is produced from household wastes and livestock wastes as cow dung is used as Bio-gas for cooking. Rudrapur Board mill is totally depends on paper waste which they collect from the surrounding villages, shops, malls, waste collectors etc. They engaged some people to collect this wastes and they pay Rs.6.5/- for 1 kg waste. In Barrackpore Municipality, the solid wastes are collected from the households then the solid wastes are dumped in the roadside vat. Solid wastes are collected from these vats then they are taken to the dumping sight at regular basis. The drain wastes are also taken to the dumping sight located at Muktapukur. In Vivekananda Institute of Biotechnology, waste management is done by biogas plants [32].

3. CONCLUSION

Municipal solid waste management is very important for a clean and healthy environment. The following conclusions could be drawn from the studies:

- Most of the MSWM practices existing in India are not satisfactory and do not follow the MSW management and handling rules. Among the studies, Pune city had satisfactory SWM practices because of implementation of efficient and scientific MSWM practices, door to door collection, public awareness and participation.

- In India different regions have different meteorological parameters, environmental conditions, geological, socio-economic and cultural conditions. So we could not fix a single solution to be applied throughout India.

- For future, studies should be focused on basis of climatic conditions, socio-economic-cultural pattern and geographical conditions.

More studies need to be conducted and stringent laws must be enforced for proper municipal solid waste management. Awareness should also be created among people and authority for proper waste management practices.

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ELECTROCOAGULATION FOR THE TREATMENT OF WATER AND WASTE WATER- REVIEW

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ABSTRACT: Electrocoagulation is an effective water treatment application which is going through a period of thorough researches for the past 10-20 years. Even if a good amount of researches has already been done the opportunities for further research on the area is still open, which shows the vastness of applications of the process. Here the aim of this work was to analyze the studies that has been done on the field so that it will be helpful in making a clear idea of the present status. The review has done on the applications of electrocoagulation under the 7 headings colour removal, metal ions removal, arsenic removal, fluoride removal, waste water reuse, leachate treatment, and COD removal. The maximum removal obtained for COD, arsenic, colour and chromium are 89%, 98.56%,99%, and 100%. Efficiency was higher when pH less than neutral. Optimum electrolysis time varies between 15-120 min. The review suggested an idea that the process can be made economical under optimized conditions.

Keywords: Electrocoagulation, colour removal efficiency (CRE), metal ions removal, arsenic removal, fluoride removal, leachate treatment, and COD removal, colour removal efficiency (CRE), microfiltration (MF), ultrafiltration (UF), reverse osmosis(RO),

1. Introduction

Growing demand for fresh water resources has made municipal wastewater reuse an attractive method of conserving and even increasing available water supplies. Over 50% of the water demand from domestic and industrial applications could be met by water of flushing, garden water, and car washing[1].

Electrocoagulation had been reported to offer various advantages over conventional coagulation, specifically in relation to hydraulic retention time, removal efficiency of ultrafine particles, coagulant dosage, sludge production, cost, and operating and maintenance simplicity[2][3][4]. Conventional reclaimed water treatment processes were effective in integrating secondary treatment with advanced treatment methods, such as microfiltration (MF), ultrafiltration (UF), reverse osmosis(RO), and chemical coagulation. However, such processes require a large serving area for treatment facilities and professional staff for operating and maintaining these treatment facilities. The electrocoagulation process offers an alternative to the aforementioned approaches that has the advantages of compactness and economic competitiveness.[5]

2. Applications in water treatment

2.1 Colour removal

Electrocoagulation treatment achieves a fast and effective reduction of pollutants (95% of dark colour) present in fresh and stored olive mill wastewater[6]. 99.59% dye removal was observed for initial dye concentration of 100 mg/L with current density of 41.7 A/m2, initial pH of 4.0 at the end of 30 min of operation. It was observed that an increase in current density, time of operation and decrease in inter electrode distance improved the dye removal efficiency[7]. The maximum CRE (98%) for a synthetic dye solution was obtained at the optimum conditions of current density of 625 A/m2 and a pH solution of 11 for an electrolysis time of 120 min. Electrochemical treatment of industrial effluent containing Reactive Black B, Orange 3R, and Yellow GR dyes were carried out at the optimum values of the parameters and a CRE of 93.5, 92, and 91.1% was obtained for the three dyes, respectively [8]. Similar colour removal results were obtained by[9]and [10] also.

2.2 Metal ions removal

The removal efficiencies of copper and zinc, after 15 min of electrolysis at 0.8 A, reached value as high as 99.9%, when pH exceed 4. In the same conditions, the removal yield of chromium reached a maximum of about 83% and seemed to be not affected by pH[11]. Longer electrolysis times are necessary for chromium, cadmium and cobalt removal. Lower efficient removal of chromium compared to zinc, copper and nickel and the less efficient removal of cadmium and cobalt. Iron is very effective as sacrificial electrode material for heavy metals removal efficiency and cost points [12]. (Shiv Kumar Verma et al. 2013) reported that a 100% chromium removal efficiency was obtained for both trivalent and hexavalent chromium, for an electrolysis time of 45 min at pH 4 . It was found

that Cr(VI) is initially reduced to Cr(III) in the acidic medium. An increase in the pH of the effluent was also noticed in the acidic medium due to the generation of hydroxyl ions. Experiments were performed for the removal of chromium using ferric chloride as the coagulant, and it was found that electrocoagulation is more efficient and relatively faster compared to chemical coagulation[13]. In chromium removal Energy consumption and the operating cost decreases with increasing initial concentration of hexavalent chromium and sodium chloride concentration, and increases with increasing initial pH of the solution and the applied current[14].

2.3 Arsenic removal

For arsenic removal, usually iron/ aluminum electrodes are used to generate $Fe2+ /Al3+$ ions, which subsequently form ferric/aluminum hydroxide to remove the dissolved arsenic by adsorption, co precipitation and surface complexation[15][16]. (Chanchal Majumder et al. 2011) reports that Time (t) and current (I) were found to favor the removal in increasing order of significance. Arsenite concentration(As) and volume (V) have unfavorable effect. Area (A) and most of the higher order interactions were found to be insignificant. Optimum removal (98.56%) is obtained at higher As (1.18 mg/L), lower volume (1 L), higher current(3 A), and higher EC processing time (120 s)[17].

2.4 Fluoride removal

Fluorine, the lightest member of the halogen group is the most electronegative and hence chemically reactive[18]. Presence of fluoride in traces has beneficial effects on teeth but high and continuous exposure can cause mild dental fluorosis to crippling skeletal fluorosis. Desirable limit of fluoride is less than 1 mg/l[19].(Sinha R et al. 2012) reports that, in continuous flow reactor, optimum results for de fluoridation of control samples were determined at current density of 25 A/m2 and flow rate of 150 ml/min and results of groundwater sample followed the trend[20].(Nadjib Drouiche et al. 2012) reports The De fluoridation was found to be dependent on the initial pH distance between electrodes and the applied potential. The most effective conditions to achieve standard discharge for fluoride by electrocoagulation was obtained with typical operating conditions; 30 V applied potential, 40 min operating time and pH 6[21]. (Nadjib Drouiche et al. 2012) also mentions future work should include the influence of residence time, energy consumption, initial concentration of fluoride and the presence of other

elements in pre-treated wastewater in order to scale-up the process[21].

2.5 Waste water reuse

Over 50% of the water demand from domestic and industrial applications could be met by water of lower quality than fully treated water, including applications such as process water, toilet flushing, garden water, and car washing[1].Designing a reclaimed water system provides an economically and environmentally favorable method for disposing of wastewater. However, some critical influences on on-site reclaimed water systems, such as limited building area, often limit the effectiveness of conventional treatment methods, when optimized; the total cost for on-site domestic grey water reuse by electrocoagulation is about ₹18.24/m3 [5].

2.6 Leachate treatment

Landfilling is the most widely used method for the waste treatment. Leachate is commonly generated from precipitation, surface run-off, and infiltration or intrusion of groundwater percolating through the landfill [22].By (Nanny et al. 2002) infiltration of rainwater through solid wastes results in the production of landfill leachate. The composition of this leachate depends on a variety of parameters, such as the type of waste, climatic conditions, mode of operation, and age of the landfill [23]. (Xiangdong Li et al. 2011) reported that electrocoagulation can be used to the leachate pre-processing. Under conditions of iron electrode, 4.96 mA/cm2 current density, 2319 mg/L Cl- concentration, 90 min electrolysis time and unchanged the raw pH, the removal efficiencies of COD, NH3-N,BOD5 and turbidity are 49.8, 38.6, 84.4 and 69.7%, respectively[24].(R. Gandhimathi et al. 2014) reports that EC is an efficient process for treating stabilized leachate. It was observed that the temperature and pH of the treated leachate increased with increase in electrolysis time and current density. A 67% COD removal was observed when electrocoagulation was performed for an electrolysis time of 30 min and a current density of 666.6 A/m2. After comparing chemical coagulation with electrocoagulation, EC had better treatment efficiency[25]. Toxicity of landfill leachate is a well-known phenomenon. Landfill leachate exhibited acute toxicity toward the bacterium Vibrio fischeri, the freshwater rotifer Brachionus calyciflorus, and the freshwater crustaceans Thamnocephalus platyurus and Daphnia magna [26]. So toxicity analysis could be done.

2.7 COD removal

(Guohua Chen et al. 2000) Reports The removal efficiency of COD was 88%, with retention time being <4.5 min. The amount of dried sludge is 0.20–0.37 kg/kg (COD removed). The total electrolysis energy consumption is 0.5 kWh/(m3 wastewater) under typical operating conditions. Classical jar test at pH 5.50 when PAC or alum used as chemical coagulant showed that a COD removal of 78% may be accomplished with Al dosage of 0.32 kg/m3; corresponding to 8.34 kg COD removed per kg Al[27]. Electrocoagulation, With 100 A/m2 current density, and operating time of 10 min, applied to the wastewater with original pH 6.90, yielded 50% of COD removal [28]. In (Abhijit M. Deshpande et al. 2012), a sequential electrocoagulation –electro oxidation treatment system was found to be highly efficient, with 61.3% COD removal efficiency. Under operating conditions (CD 80 A/m2; pH 7.2), EC resulted in 24% after 25 min, whereas the EO yielded 35.6% chemical oxygen demand (COD) removal after 90 min of treatment[29]. By using aluminum and graphite plates alternated in the electrode pack and operated at current of 0.4 A during 90 min of treatment with pH adjusted to approximately 7.0, chemical oxygen demand (COD) removal reached 90% [30]. The treatment of waste water using aluminum electrodes was affected by the initial pH, the current density, electrodes distance, NaCl Concentration, and rotational speed The results showed that optimum operating conditions were found to be an initial pH of 7, current density of 25mA/cm2, rotational speed of 100 rpm, NaCl concentration of 1 g/l and electrolysis time of 60min. This experimental study clearly showed that under the optimal conditions, about 89% COD was successfully removed.[31]

3. Conclusion

From the literature review carried out below given conclusions have derived,

- Electrocoagulation gives an advanced, economical and quick method for the treatment of wastewater especially on hilly areas affected by winter; where biological and chemical treatments are inefficient during that season.

- This process can give advantage over other techniques on areas where electricity is sufficient.

- Electrocoagulation method having a wide range of applications can be a single method to treat a large variety of pollutants and can be a single answer to water treatment issues.

- Various parameters like pH, current density, time of treatment, distance between electrodes depend on the process.

- As the process going on pH of the solution can increase so less initial pH is preferable.

- Temperature has less affection on the process unlike conventional treatments.

- The maximum removal obtained for COD, arsenic, colour and chromium are 89%, 98.56%,99% and 100%.

- In all the removal processes removal efficiency is higher when pH is less than neutral.

- Optimum electrocoagulation time varies from 15-120 min depends on the process.

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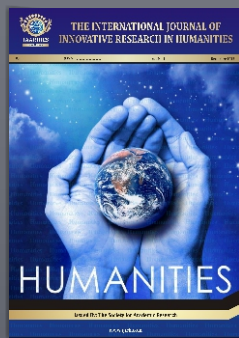
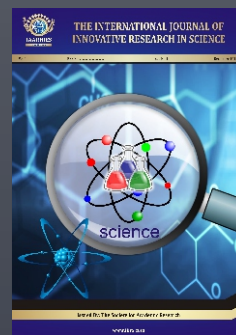**The International Journal of
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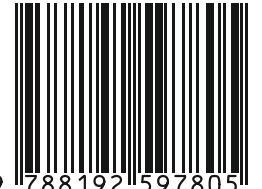**The International Journal of
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