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S & T Review

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Teerthanker Mahaveer University

Teerthanker Mahaveer University has been established by an 'Act' (No. 30) of 2008 of the Government of Uttar Pradesh and is approved by the University Grants Commission (UGC) vide letter No. F. 9-31/2008(CPP-1) dated October, 2008. The University is located on National Highway-24, barely 144 Km from New Delhi.

The University stands committed to the ideals of Lord Mahaveer – Right Philosophy, Right Knowledge, and Right Conduct – in all the spheres of activity and aspire to be recognized as the ultimate destination for world class education.

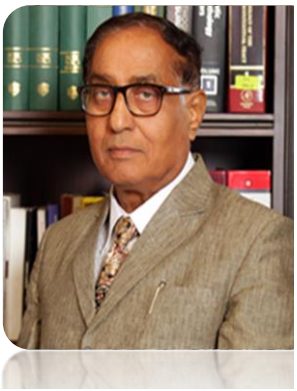
The multi-disciplinary University offers career oriented courses at all levels, i.e., UG, PG and Doctoral degrees across diverse streams, namely, Medical, Dental, Pharmacy, Nursing, Paramedical Sciences, Physiotherapy, Hospital Administration, Education, Physical Education, Engineering, Architecture, Polytechnic, Management, Law, Journalism, Fine Arts, Jain Studies, and Agriculture Science to meet rising aspirations of the youth.

Faculty of Engineering & Computing Sciences

The College of Engineering has emerged as a hub for academic excellence in engineering training. The college contributes to quality education in all major disciplines of engineering and technical education and helps meet the needs of industry for trained technical manpower with practical experience and sound theoretical knowledge.

The college was established by the university with the aim of providing relevant, essential, upgraded education to the young aspirants in the field of computer science and engineering, including computer applications. In recent times and the years to come there will be increasing demand of skilled manpower in the domain of Computer Science and Engineering because of the 'Digital India' mission projected around the globe by Government of India.

S & T Review is a peer-reviewed, and multidisciplinary engineering journal that publishes original research, case studies, & review articles of all major branches of Engineering, Science and Technology. The Journal does not charge for publishing any manuscript. The papers contained in the journal carry the opinion and view of the contributors and not necessarily of the editorial Board. The editorial Board as such shall not be responsible for the authenticity and legality concerns regarding the submission made in this journal. The entire responsibility shall lie with the author of the papers or case studies.



CHIEF PATRON

Shri Suresh Jain

Hon'ble Chancellor

Teerthanker Mahaveer University, Moradabad

I am extremely glad and in a state of inner happiness on the arrival of vol-7 and issue-1 of S &T Review, an International Journal of Science and Technology and for this Faculty of Engineering and Computing Sciences deserves great applause. Since the world is growing very rapidly and no doubt creative researches have changed the entire technology in the domain of Engineering, Medical Sciences, Computing Sciences and variety of industrial products. Certainly, research in any discipline is not a one-day task as consistence and continuous efforts are required to put in for the sake of making it constructive for the betterment of entire mankind. Gone are the days when things used to seem impossible. The contemporary time witnesses the era wherein technology is creating wonders. In a world heralded by technology, research in academic institutes lays the foundation of a nation's growth and well-being. The University, since inception, is a research-driven university which, on one hand, strives to educate the students and on the other, endeavours to discover new knowledge frontiers through research. This is, heart pleasing to notice that Faculty of Engineering & Computing Sciences remains in sync with expanding frontiers of academics and industrial practices through various on-going research projects and collaborations with many national and international organizations. The college works diligently to realize its mission of providing the best learning, teaching and research opportunities to students and academicians alike, it continues to supply students with the basics of modern knowledge and high values. I would like to put into records sincerest appreciation and heartiest felicitations to Prof (Dr) R. K. Dwivedi, Director and Principal, FoECS, and Editor- in- Chief S&T Review, Associate Editors, Advisory Committee for bringing out the journal successfully up to the extreme satisfaction of research students, researchers and scientists on regular interval.

I believe that the college will continue to mark revolution through quality research work to bring laurels to Teerthanker Mahaveer University in India and abroad.

Institution is doing surprisingly great in all directions. Wishing a bright future to all stakeholders!

CHIEF PATRON

Shri Manish Jain
Hon'ble Group Vice Chairman,
TMU, Moradabad

Stellar accomplishments broaden the frontiers of knowledge and scholarship with each passing day. In this eon of Globalization of education, the apparent emphasis is on the quality of education. Since there is nothing which stands as a single yardstick of quality, a good educational institution, therefore, strives unceasingly for sustenance and enhancement of quality in every field of its activity be it academics, research or extra-curricular.

Education defines the path of progress and prosperity for which Faculty of Engineering & Computing Sciences is very much committed as it is evident from the various activities carried out throughout the year under the vigilant supervision of Professor R.K. Dwivedi, Director & Principal, FoECS. Great Satisfaction & immense pleasure comes to the heart on witnessing that FoECS is publishing vol-7, issue-1 of S&T Review in the Month of December 2021 as one more step in the direction of boosting the research environment in the college. The research activities at FoECS lead to an amazing enhancement of the experience of the students since the research training provided to the students has been creating the next generation of scholars well-prepared to advance knowledge and emerging trends of technology. The college holds firm conviction that extension of research opportunities to an ever-increasing group of undergraduate students adds a dimension of experience to the undergraduate education that, for sure, cannot be duplicated in the classroom.

S&T Review, an International Journal of Science and Technology stands as a witness to the monumental efforts taken by the college under the worthy guidance of Prof. R. K.Dwivedi, Director & Principal FoECS to make the college as centre of excellence in education and research.

I extend my greetings and bests wishes to the team FoECS and wish their endeavours for future prospects.

PATRON

Prof. Raghuvir Singh

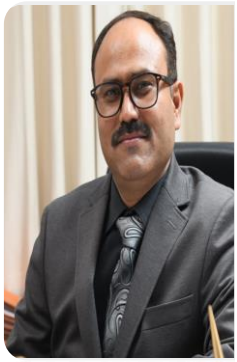
Hon'ble Vice Chancellor,

TMU, Moradabad

The contemporary time witnesses an era which is truly defined as a fast changing world, a changing society which has been progressing at a galloping speed and there is no exaggeration in saying that impact of science, scientific research, technological development and globalization on our daily life is vibrant and inescapable. Consequently, the requirement to be geared up for tomorrow is surely greater than ever since the advent of life on earth. With this mind, the university continues to march progressively towards its aim to provide responsible citizens who will record their valuable contribution in nation building. Known to all, the progress of nation depends upon the quality of teaching-learning process along with research activities. Keeping the same in mind, together with providing responsible citizens, effectiveness and efficiency of aforesaid is the goal of the university. FoECS is simply unstoppable in its progress as it has been actively involved in countless activities that have brought to light the hidden talents of the college students and staff. The highly qualified and dedicated members of the college, since inception, have always been standing shoulder to shoulder with the management and have been carrying out their duties with a level of commitment.

University education system, particularly technical education, requires a platform to encourage budding researchers for publishing their research output in the form of journal articles. Heart receives enormous pleasure to notice the publication of current issue of S & T Review, an International Journal of Science, and Technology which is serving as a platform for publishing the research works covering all branches of Engineering and allied fields. These scholarly publications will be a medium for academic and scientific discussions and enrichment of research areas which will finally lead to the overall development of the community and society at large.

Congratulations to Prof. R.K. Dwivedi, Director and Principal, FoECS, Editor-in- Chief, Associate Editors, Section Editors and Advisory committee to motivate a positive environment of research in the college.



Editor in Chief

Prof. (Dr.) R. K. Dwivedi

Principal & Director, FoECS

TMU, Moradabad

Faculty of Engineering & Computing Sciences is well known for the way it is moving ahead on the road of academic excellence in conjunction with dedicated modus operandi towards dissemination of knowledge in the academic world. The College strongly advocates the role of research in education, hence is committed to ripen an inclination on the way to research in both faculty and students. In this quest, the College has taken the initiative to unveil yet another issue of the journal named S &T Review, an International Journal of Science and Technology to embolden researchers and academicians to pursue research.

My heart brims with great joy and happiness on noticing the efforts the team putting in for the publication of S&T Review. With an aim to uphold high academic standards in line with academic ethics and academic integrity, a rigorous process of blind review of research papers is embraced accompanied by screening of plagiarism of each manuscript received by team S&T Review for publication. The research work published in the journal, beyond the shadow of doubt, is original which are neither in print nor presented at any other public forum.

A deep sense of satisfaction surge through my heart in acclaiming that FoECS has been progressing by leaps and bounds and has grown in stature and strength as it has emerged as one of the finest educational institutes dedicated to the pursuit of knowledge and experience. I believe that the current issue of Volume 7, alike preceding issues, will add lustre to college's prestige.

In the words of great visionary Hon'ble former president Dr APJ Abdul Kalam:

"Learning gives creativity, Creativity leads to thinking,
Thinking leads to knowledge, Knowledge makes you great."

May the quality education FoECS has been imparting to the students enlighten their minds and ignite the spark of aiming high in their hearts

S & T Review

Volume -7 Issue-2, December 2022

ENHANCEMENT IN HYDROGENATION BEHAVIORS BY GOING OFF STOICHIOMETRY IN TI-V BASED ALLOY TAILORED WITH EXCESS TI

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Abstract

The boost in hydrogenation behaviour of $Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloys, recognised to be a viable candidate for the Ti-V system of alloys hydrogen storage, is described and discussed in the current work. According to research, adding more Ti to the formula $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.02, 0.03, 0.04, 0.05, and.06) increases the plateau pressure up to 2.5 atmospheres at 100 ºC. Additionally, the surplus Ti alloy activates quickly and begins to absorb a large amount of hydrogen from the very first cycle. According to the current research, altering the stoichiometry of one of the native elements may be more successful than using foreign elements to make the hydrogen storage material suitable for devices.

Keyword: *Hydrogen storage alloy**;** Pressure–composition–isotherms; Cyclic stability; Laves phases*

1. Introduction

Out of various hydrogen storage hydrides namely elemental hydrides MgH_2, AlH_3, intermetallic of AB (e.g FeTi), AB_2 ($ZrFe_2$), AB_5 ($LaNi_5$), complex hydrides like alanetes, imides/amides etc., the intermetallic hydrides have few favorable features. They have high volumetric storage capacity (≥ 40 Kg/m^3) and exhibit much better reversibility than their counter parts such as complex hydride like alanates (typified by $NaAlH_4$). Amongst the intermetallic the Laves phase BCC solid solution alloys finds a special place. Ti–V-based BCC Laves phase related solid-solutions having high absorption storage capacity at nearly room or moderate temperatures are materials of potential importance [1-10]. It has been reported that multi-phase Ti–V–Mn alloys consisting of Laves and BCC solid-solution phases have good hydrogen sorption capacities [11-12].

Because of high hydrogen storage capacity (≥ 2 wt %), the alloys as given as Ti–V having large potential to absorb hydrogen which may find its place in hydrogen based devices. The Fe substituted version of Ti-V based alloys particularly $Ti_{43.5}V_{49.5}Fe_{7.5}$ absorbs up to 3.9 wt. % hydrogen at 80 ºC [13-15]. Some recent studies on Ti–V and the substituted versions are those of Basak et al. on $Ti_{0.85}V_{0.95-x}Fe_{0.15}Zr_x$ alloys [16] and Hang et al. on $Ti_{10}V_{84-x}Fe_6Zr_x$(x = 1–8) [17]. In both these, the authors investigated the effect of Zirconium (Zr) in place of Vanidium (V) so as

to improve the activation behaviour. These alloys having two crucial disadvantages. One of these relates to the difficulty in activation**.** The activation of Ti-V alloys needs to be improved. The second relates to the low plateau pressure P_p (often < 1 atmosphere) of these alloys. For most of the Ti-V type storage alloys**,** P_p is low. For the alloy with composition $Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$, the ($P_P$) (desorption) is below one atmosphere (10^{-3} mbar at 100^{o}C) [16]. The required convenient working pressure at which hydrogen can be delivered by the storage system to the commonly used devices should be moderate (one to few atmospheres). Because of the said factors, the P_p of the Ti–V storage alloys needs to be enhanced to at least ~ 1 atmosphere through material tailoring.

It may be pointed out that in most of the studies on Ti–V and its substituted versions, the hydrogenation studies are confined to hydrogen absorption [18]. Only sparse studies have discussed about desorption behavior of these types of alloys. For application, the desorption characteristic (which delivers hydrogen from the storage system to the device) is more important. The alloy Ti–V has been tailored by several investigators to improve the sorption behaviours. However, the various studies on Ti-V-Fe-Zr so far are not focused on making P_p amenable i.e. greater than 1 atmosphere, together with ease of commencement of activation i.e hydrogen sorption right from the first cycle.

Keeping these aspects in view, attempt has been made in the present investigations to carry out materials tailoring of the earlier known optimum alloy $Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$ [16]. This alloy was taken as the reference alloy. We attempted materials tailoring in a manner different than those attempted so far. These early studies are focused on substitution of elements Fe, Co etc (for Ti) and the elements Zr, Cr etc. (for V). Substitution of foreign elements at the structure matrix sites besides producing strain may also lead to creation of lattice defects producing considerable hysteresis. Here, we varied concentration of one of the native elements of the optimum reference alloy so as to go off stoichiometry as compared to the known optimum alloy. We have tried going off stoichiometric in both V and Ti which have the highest concentration in this ternary alloys. However, only the latter was found to be advantageous. Thus the alloy $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x= 0.02, 0.03, 0.04, 0.05 and 0.06) has been investigated extensively in the present work. It is found that this alloy not only shows easy activation but also exhibits sorption behaviour above one atmospheric pressure (P_p > 1 atmosphere). These characteristics would make this alloy amenable for applications.

2. Experimental Details:

2.1 Synthesis

The multi component $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloys with varying amounts of Ti (x = 0.02, 0.03, 0.04, 0.05 and 0.06) were created by melting a stoichiometric mixture of Ti (99.9%), V (99%), Fe (99.9%), and Zr (99%) in a silica tube-enclosed outgassed graphite crucible in a radio frequency induction furnace (18 kW). To minimize the oxygen content in the silica tube, we have melted a separate Ti pellet before melting the alloy ingot. The prepared alloy ingot was melted for several (3-4) times to achieve higher homogeneity.

Water is pumped around the silica tube in the outer jacket while it melts to lessen alloy contamination. By melting Ti buttons for each composition that was prepared, the melting atmosphere was further cleaned thanks to Ti's beneficial properties as an oxygen-gather. The alloy ingot obtained in such a way was removed from graphite crucible, then crushed and subjected to characterizations and evaluation of hydrogenation behaviors.

2.2 Characterizations

Before the evaluation of hydrogenation behaviour measurement, the compounds were analyzed by XRD, employing a X' Pert PRO PANalytical X-ray diffractometer equipped with graphite monochromator using CuKα radiation. The powder X-ray diffraction confirmed the crystal structure of the reference and excess Ti bearing alloys.

Scanning electron microscopy (SEM) in secondary electron imaging mode with Philips XL-20 and FEI QUANTA-200 and transmission electron microscopy (TEM) with a Tecnai 20 G2 electron microscope at 200 kV were both used to examine the surface microstructural characteristics of the as-synthesized and dehydrogenated samples. An EDX attached to an FEI QUANTA - 200 and Tecnai 20 G2 electron microscope was used to conduct a chemical analysis.

2.3 Hydrogenation Behaviours

The hydrogenation (absorption/desorption) behaviours were studied on a P-C-I (pressure-composition-isotherms) measurement system acquired from Advanced Material Corporation (A.M.C), Pittsburgh, USA, as well as on a Sievert's type high-pressure volumetric system developed in our laboratory.

Under vacuum, the sample was cooled to its operating temperature. Next, hydrogen was added to the reaction space. The pressure-composition isotherm (P-C-I) experiments have been conducted

between 1 and 20 atm of pressure and 25 and 100 °C of temperature. The material was thoroughly dehydrogenated following each cycle using high vacuum and heat (10-5 mbar).

3. Results and Discussions:

3.1 Structural and Microstructural characterizations

Fig. 1 shows the XRD patterns of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (a) as reference (x=0.0) (b) optimum (i.e. x = 0.02) and (c) highest Ti content (x = 0.06) alloys. It is observed from the XRD patterns that the alloys based on BCC solid/solution are biphasic in nature with C_{15} along with V phase. It may be pointed out that for Ti-V-Fe-Zr alloy, two types of secondary Laves phases namely C_{14} (hexagonal) and C_{15} (cubic) have been found to exist together with the V based BCC solid solution [19, 20]. However, in the current work, only the C15 secondary Laves phase and V-based BCC solid solution are present in the alloy with excess Ti (x= 0 to 0.06) alloys ($Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$). By observing the change in intensity of the (220), (222), and (440) XRD peaks of the C15 phase, it is possible to deduce the rise in the concentration of C15 Laves phase (Fig. 1).

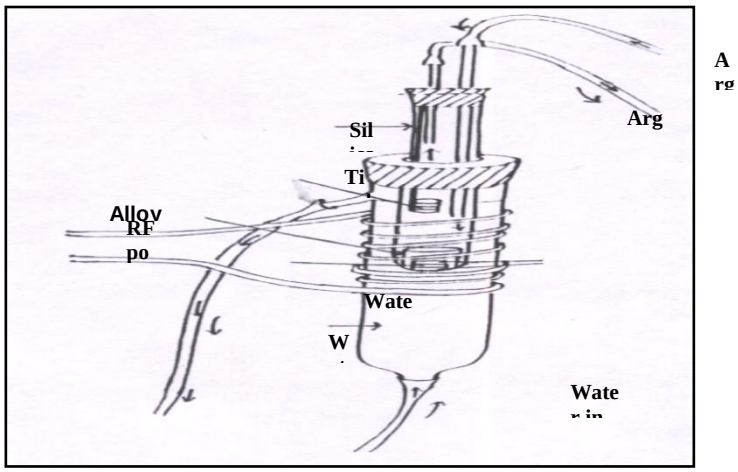

Figure. 1 Schematic diagram for preparation of alloys.

The powder X- ray diffraction profile was analyzed using Jana -2006 for Lebail fitting It may be pointed out that the (110) peaks from the V based BCC solid solution phase and the (311) peak from the C_{15} phase are nearly overlapped at the same 2θ angle as evident from Fig.1. The lattice parameters of the V based BCC solid solution and the C_{15} Laves phase have been calculated based on the XRD patterns, are shown in Table. 1.

Table. 1 Variation of lattice parameters and unit cell volumes of the reference (x = 0.0) optimum (x =0.02) and highest Ti content (x =0.06) alloy

S.No	Compositions	Lattice Parameter	Unit cell Volume
1	$Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.0)	C_{15} Laves phase a= 6.0314Å BCC solid solution a = 3.0460 Å	219.4089 $Å^3$ 28.2611 $Å^3$
2	$Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x =0.02)	C_{15} Laves phase a = 6.0043 Å BCC solid solution a = 3.0469 Å	216.4647 $Å^3$ 28.2862 $Å^3$
3	$Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x =0.06)	C_{15} Laves phase a= 5.9501Å BCC solid solution a = 3.0476 Å	210.6555 $Å^3$ 28.3057 $Å^3$

The excess Ti promotes the formation of C_{15} Laves phase as evidenced from the microstructure revealed by a typical SEM micrograph shown in Fig.2.

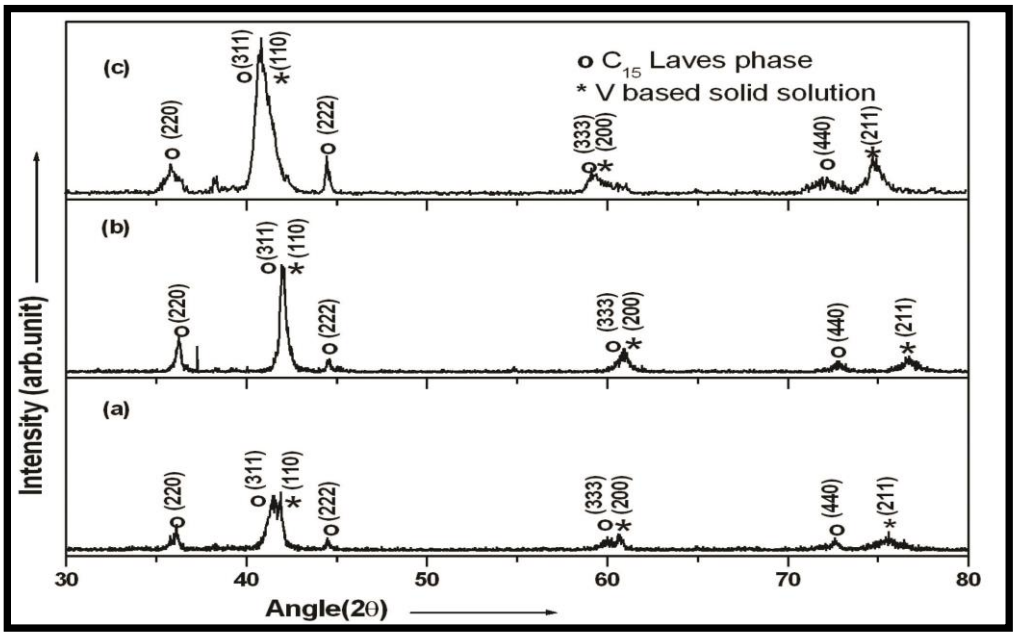

Figure.2 XRD patterns of $Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$ (a) as synthesized (reference material) (b) $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x=0.02) alloy and (c) $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloy (x=0.06) alloy (* ≅V based BCC solid solution, o ≅ C_{15} Laves phase). The intensity scale in arbitrary units is the same for XRD patterns of all the alloys.

The SEM microstructure (polished and leached with HNO_3 + H_2SO_4) of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$(x = 0.0 and 0.06) alloys are presented in Fig 2(a) & (b). Biphasic V based solid solution and C_{15} Laves phase microstructures are observed for x = 0.0 and 0.06. It can be

seen that the microstructure of the $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ with x = 0 alloy consists mostly of BCC solid solution with C_{15} Laves phase, however with x=0.06 the precipitate of the C_{15} Laves phase along with the grain boundaries in the V based solid solution increases(Fig. 2 (b)).The SEM micrograph as shown in Fig.2 does suggests the formation of C_{15} (Ti rich phase) arranged in a linear way between the two regions of the present phase alloys which is clearly seen from the inset of Fig. 2 (b). These dendrite like linear arrays are presumably grain boundaries, where Ti gets precipitated. These sites may work as nuclei for the formation of Ti rich C_{15} Laves phase. In the parent alloy i.e. x=0, C_{15} Laves phase regions are distributed randomly (Fig.2 (a)). On the other hand for the excess Ti samples C_{15} Laves phase regions are located along the linear grain boundary regions. In the present case, the high densities of C_{15} Laves phases have been observed in the BCC solid solutions in optimum alloy at x=0.02. Fig.2(c) shows cross-sectional SEM of from Ti rich (x=0.02) alloy showing uniform dispersion of C_{15} Laves phase in the alloy. The alloys were additionally examined by TEM in order to look at the phases and microstructure in greater detail. Figure 3 depicts a typical TEM picture of the $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloy with x=0.02 (a).

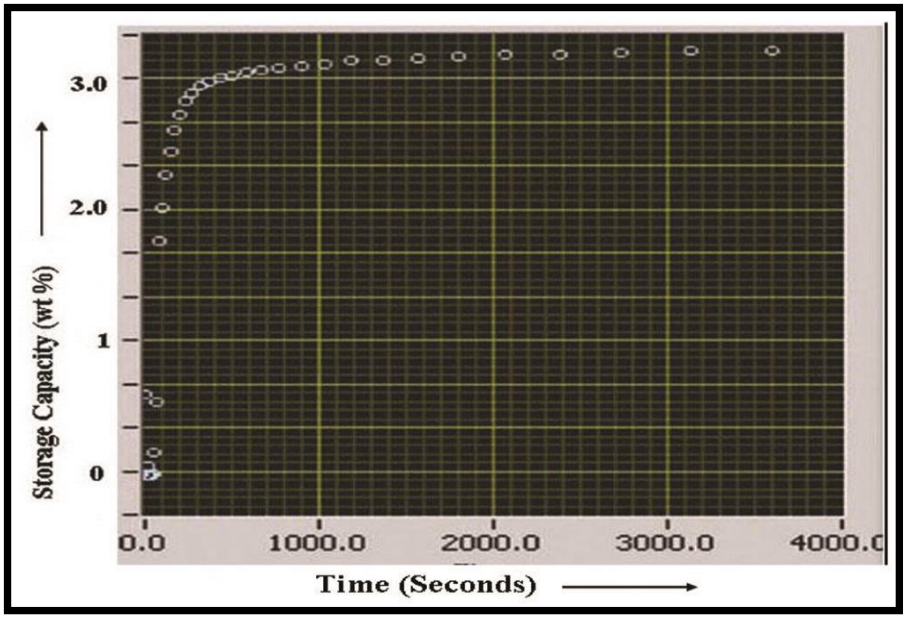

Figure.3: Representative absorption kinetics curve of the $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$(x=0.02) material at room temperature right from the beginning.

Two different types of microstructure have been found in a single grain, giving the appearance that they are two distinct phases. Figure 1 displays the relevant selected area diffraction (SAD) patterns from three distinct regions, A, B, and C. 3(b), (c), and (d), accordingly.

From region A, the patterns (Fig. 3(b)) have been indexed as a V base solid solution phase with a= 3.04 Å, from region B, the patterns (Fig. 3(c)) have been indexed as a C_{15} laves (BCC with a=6.03 Å) phase and from region C, we have observed two different type of patterns containing reflection from both phase (Fig.3(d)), where small unit have been indexed with as a C_{15} Laves (BCC with a=6.03 Å) phase and the bigger unit have been indexed by V base solid solution phase with a= 3.04 Å. These findings agree with those of the XRD study. The energy dispersive X-ray analysis (EDX) method was used to determine the composition of the alloys. Each alloy underwent EDX microanalysis, which revealed an average composition over the entire sample that was consistent with the nominal one. Table 3 presents the findings of a representative EDX investigation. According to the EDX analysis, the produced alloys almost exactly maintain the correct stoichiometry ratios of the constituent elements. Table.3 provides concise descriptions of the excess Ti concentration for alloys with x = 0.0 (reference), 0.02 (optimum), and 0.06 (highest).

3.2 Improvement in plateau pressure

Table. 2 Hydrogenation behaviors of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x= 0.02, 0.04, 0.05 and 0.06) alloys

S.No.	Compositions (x)	Absorption Capacity (wt%)	Desorption Capacity (wt%)	Plateau Pressure (P_p) (atm)	Desorption temperature (°C)	Desorption Kinetics (min)	Cyclic Stability
1	0.02	3.49	2.01	~1.4	100°C	45	good
2	0.03	3.40	1.93	~ 1	100°C	39	good
4	0.04	3.35	1.89	~1.7	100°C	35	good
5	0.05	3.31	1.73	~1.9	100°C	33	good
6	0.06	3.29	1.69	~2.5	100°C	30	good

A very fast activation obtained from sample $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ for x = 0.02. (in 30 seconds itself hydrogen gets absorbed up to more than 3 wt%) (Fig.4) whereas, for x = 0.0, hydrogen absorption takes place in several minutes. It is known that there is a direct relationship between

plateau pressure and unit cell volume i.e. when the unit cell volume decrease, the hydrogen plateau pressure increase and vice versa [20-21].

Table. 3 Elemental concentrations of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x=0.0, 0.02 and 0.06) alloy

Element Ti.85+x(x= 0) Reference alloy	**At%Expected**	**At% (average) Observed**
Ti	42.50	41.07
V	47.50	48.15
Fe	7.50	6.85
Zr	2.50	3.13
Element Ti.85+x(x=.02) Optimum alloy	**At% Expected**	**At% Observed (average)**
Ti	43.50	43.85
V	47.50	47.49
Fe	7.50	8.55
Zr	2.50	2.11
Element Ti.85+x(x=.06) Maximum alloy	**At% Expected**	**At% Observed (average)**
Ti	45.50	44.35
V	47.50	47.05
Fe	7.50	7.01
Zr	2.50	1.59

The explanation of this correlation is as follows: the larger the unit cell volume, the larger the interstitial hole size, the smaller is the strain energy produced when hydrogen occupies an interstitial site. As a consequence, the plateau pressure (P_p) will be lower for the compound having larger unit cell. The P-C-I desorption curves of the $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x= 0.02, 0.04 and 0.06) are shown in Fig.5. With increasing x, the hydrogen desorption capacity decreases however the (Pp) increases due to decrease in unit cell volume of C_{15} Laves phase (Table.1). The hydrogen desorption plateau pressure of all the compositions studied increases from below 1 atm to above 1 atm at 100 ^{o}C (Fig.5). The related data showing the effect of the Ti content on the P-C-I characteristics are shown in Fig.5 and summarized in Table.2. With increasing x, the unit cell volume of the C_{15} Laves phase decreases (Table.1). Whereas the unit cell for V based BCC solid solution remains nearly invariant.

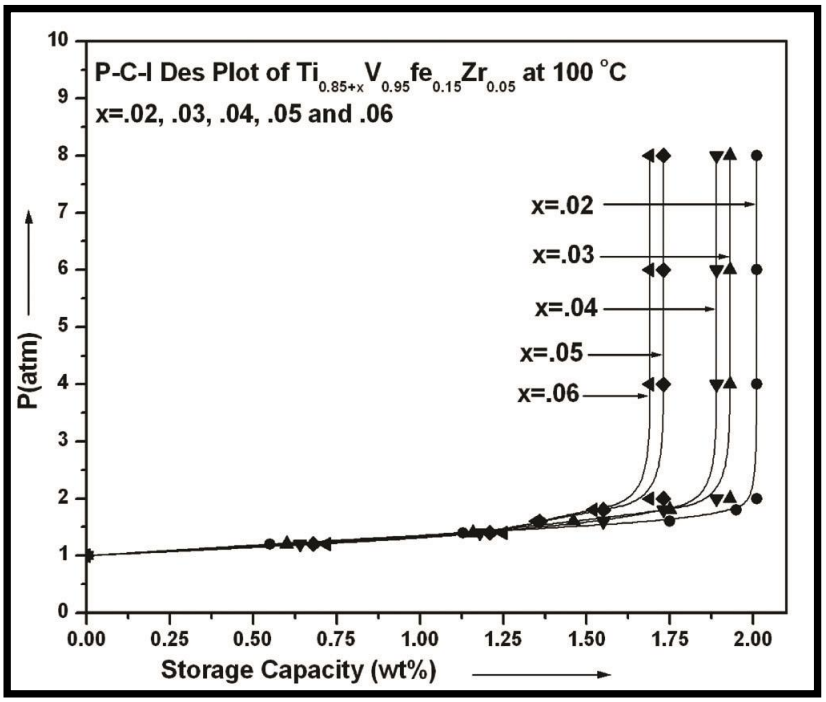

Figure.4 Representative Desorption isotherms of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x= 0.02, 0.03, 0.04, 0.05 and 0.06) alloys at 100 ° C.

3.3 Enhancement in sorpion properties

The features of hydrogen sorption have been discovered to be improved for the current alloys $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.02, 0.03, 0.04, 0.05 and 0.06). At a pressure of greater than 1 atmosphere, the alloy with x = 0.02 desorbs up to 2.01 wt% in 45 minutes at 100 °C. The optimal alloy $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.02) (without activation) has a representative hydrogen absorption kinetics depicted in Fig. 4. Table 2 lists the results for $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloys with x=0.02, 0.03, 0.04, 0.05, and 0.06, on comparing the value it can be seen that x = 0.02 is the optimum composition. Representative examples of the amount of desorbed hydrogen at 100°C (desorption starts at 80°C and goes up to saturation level at 100°C) for the $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ materials (x= 0.02, 0.04 and 0.06) are shown in Fig.5. The previous known results [16] suggest that the reference alloy $Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$ did not desorb hydrogen at ambient conditions.

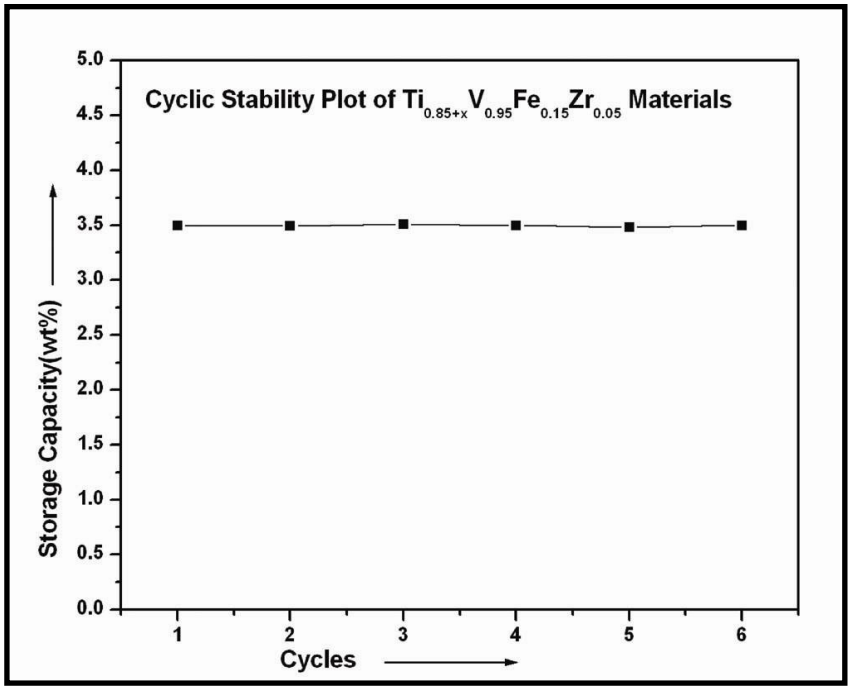

Figure. 5 Absorption cyclic stability plot of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloy.

However, in the present case, the alloys $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.02, 0.04 and 0.06) do desorb at ambient (~ 1 atmosphere) pressure. The storage capacities were found to be 2.01, 1.89 and 1.69 wt% for x = 0.02, 0.04 and 0.06 respectively at ~100^{o}C. The result on the desorption can be taken as the one of the clear cut result of its type for the Ti–V–Fe–Zr alloys. The alloy $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ with x = 0.02 which has the highest desorption capacity of 2.01 wt% and gets activated readily may be taken as the optimum alloy. The P-C-I curve have been found to be reproducible up to 6 cycles and even after this only marginal detoriation was noticed. Fig.6(a-b) shows the cyclic stability curve for $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.02) i.e. optimum alloy in absorption and desorption modes. As evidenced in microstructural investigation the C_{15} Laves phase increases with increasing Ti. Therefore, it can be inferred that the increasing concentration of C_{15} Laves phase is leading to better sorption characteristics with optimum value of Ti (x = 0.02).

The surface morphology of the alloys before and after dehydrogenation have been characterized by SEM. Fig. 6 (a) shows the SEM image of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x =0.02 optimum alloy) alloy before hydrogenation. Average particle size of the alloy is found to be about 400µm. After first activation cycle, their average particle size is reduced from ~ 400 µm to ~ 50 µm with several cracks on the surface. This can easily be seen in Fig 6(b) and Fig 6(c) respectively. These findings indicate that alloy particle fragmentation is directly related to the activation process of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ alloys. Based on the specifics of activation that are known, it is possible

to conclude that in this instance hydrogen atoms pass through the surface and create the hydride phase beneath the surface layer. Volume expansions that accompany the hydride phase's development cause the hydrided alloy to break. These small fissures allow more hydrogen to enter the alloy, and the hydride alloy's lattice expansion causes larger cracks to form.

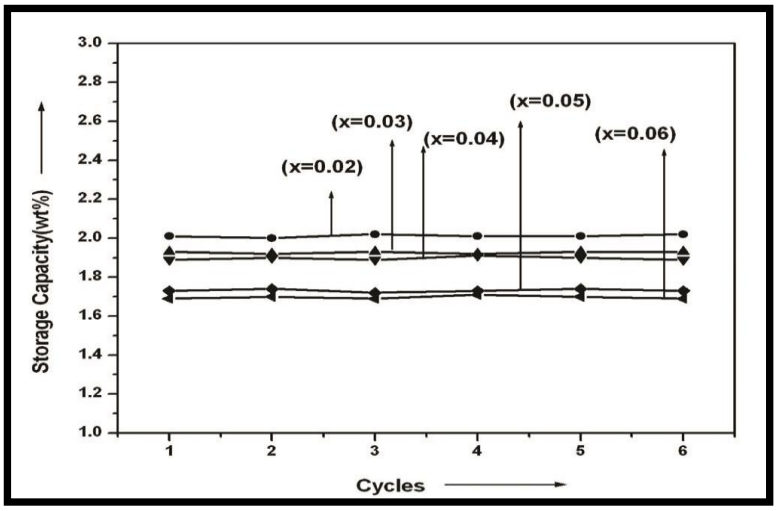

Figure.6 Desorption cyclic stability plot of $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x = 0.02, 0.03, 0.04, 0.05 and 0.06) alloys at 100 °C.

4. Conclusions

Reference $Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$ and excess Ti, $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ (x= 0.02, 0.03, 0.04, 0.05 and 0.06) alloys have been successfully synthesized in the present investigation. The as-cast alloys are bi-phasic (BCC solid solution and C_{15} Laves phase). As the content of Ti increases in the reference material ($Ti_{0.85}V_{0.95}Fe_{0.15}Zr_{0.05}$), the abundance of C_{15} Laves phase increases. The alloy $Ti_{0.85+x}V_{0.95}Fe_{0.15}Zr_{0.05}$ with x = 0.02 possessing higher desorption capacity of 2.01 wt% at 100°C and also gets activated easily. It may be taken as the optimum alloy. The alloy with excess Ti have lower unit cell volume of C_{15} Laves phase e.g. for x =0.02, 0.04 and 0.06 and hence smaller interstitial hole size. This leads to higher hydriding / dehydriding plateau pressure (from below one to above one atmosphere).

Acknowledgements

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IOT BASED GPS TRACKER SHOES FOR GIRLS' SECURITY

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Abstract

IOT based GPS tracker shoes for security provides safety to girls. It includes GPS module that sends the location by computing the latitude and longitude. GSM sends the text message and make calls to the predefined emergency numbers. Left leg shoe is used to send the location and text message and to establish the calls. Right leg shoe provides electric shock to the attacker that protects the victim from the attacker for some time. Both the shoes will work after pressing the panic button on the tip of the shoes. The whole project works on piezoelectric that charge the battery time to time while walking. Women can go anywhere without any fear. It gives them freedom and strength to face the attacker. It is cost effective and can easily reach to common people. It makes the family member of the victim stress free and they can easily reach to her by tracking the location. The true potential of this project lies in the future when IOT makes its place everywhere in India.

Keywords: *GSM; GPS; Piezoelectric; IOT*

1. Introduction

Women safety is become a major concern in today's era. It can be seen everywhere that women cannot walk safely on a road even in daytime. It is observed that only 3% of the women are those who haven't experienced public sexual harassment. It has become a social crise in many countries. 98% of the foreign women have experienced sexual harassment while living in Egypt. It means that women needs some safety to secure themselves so that they can go anywhere without any fear. In spite of too many laws and rules for women, assaulter harasses the women. There should be something for self-protection that makes the women to secure themselves from the attacker for a moderate period, so that they will be able to run from the attacker. There are many mobile apps like 'bSafe', 'Walk Safe', 'Red panic button' etc. in market that are designed by taking into consideration about women's safety that is used to send the location of victim through the smart phones to the police station. These are mentioned below-

- **Safelet –** It is a wearable women safety device having two buttons that on pressing will send a message to the guardian of the victim. This device is also connected with the user's mobile phone, so that recording will take place. In case of risky situation the concerned member who receives the alert can immediately dial the emergency number.

- **Eye watch SOS for women –** It captures audio and video of the user's surroundings and sends it to the registered contacts along with an alert message. After reaching to the safe location, the user can inform her family members by pressing the button that "I am Safe."
- **Revolar –** Revolar is an oval-shaped device. It can be easily kept inside the pocket. After pressing the button twice, it will send the message to the designated contacts with the current location.
- **Personal alarm wristlet with whistle –** It is a hidden whistle and specially designed for women safety. It can be kept inside the outer pocket of the purse and can be easily carried. The alarm is activated when the pin is pulled.

All the above devices are good. But sometimes attacker snatches the mobile, devices, watch, purse etc. and in this situation it is not possible to turn on the app. So, there should be a device that will not take too much time to run. Taking all these problems and condition in consideration we have designed an "IOT based GPS tracker shoes for girl security".

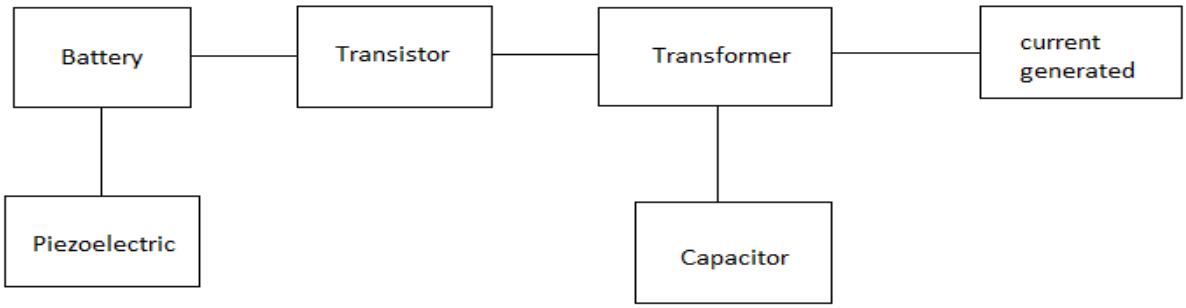
These shoes give the electric shock to the attacker as well as track the location of the victim timely. Left leg shoe sends the location to the predefined numbers and right leg shoe provides the electric shock to the assaulter. This device is fully depends on piezoelectric sensors that generate the current and recharge the batteries. GPS NEO-6M and GSM SIM800L module are used in tracking the location. Tracking process requires Arduino Nano to connect the devices.

GSM 800L is a small cellular module that is used for GPRS transmission, for receiving and transmitting messages and for making calls. GPS NEO-6M is a GPS receiver and consists of 25 x 25 x 4 mm ceramic antenna and has a strong satellite searching capability. It searches the satellite and finds the location according to the latitude and longitude. Arduino Nano is a small board based on ATmega328. It consists of crystal oscillator having frequency 16MHZ. It has operating voltage of 5V and input voltage can vary from 7 to 12V. There are 14 digital pins, 8 analog pins, 2 reset pins and 6 power pins. GPS NEO-6M and GSM works with the Arduino Nano because they require pre-programming.

2. Main Methodology

This project is based on IOT and consists of GPS NEO-6M and GSM 800L module, a shock circuit, transmitter and receiver. The whole device runs on piezoelectric sensor. Left leg shoe sends the location of the victim by pressing the push button on the tip of the shoe. Right leg shoe provides shock.

Right leg shoes- Right leg shoe contains an electric shock circuit that consists of a 909V transformer, 1kΩ resistance, IN4007 diode, BC548 NPN transistor, capacitors and a 3.7V battery. While walking piezoelectric converts the mechanical energy into electrical energy and piezoelectric sensors recharge the battery. When the victim presses the button on the tip of the shoe, current starts flowing in the circuit and the shorted wires generates high current. When the victim hit the attacker with this shoe, the attacker gets a shock and victim can save her life for a short time and if she wants, she can run from there. The block diagram of the shock circuit is shown below-



Right shoe shock circuit block diagram

It is shown above that piezoelectric is connected to the battery and will recharge it timely. The battery and 1kΩ is connected with transistor. Capacitors of 2KV are connected with the transistor and capacitors store the charge and generate the high current. Piezoelectric combination is shown below.

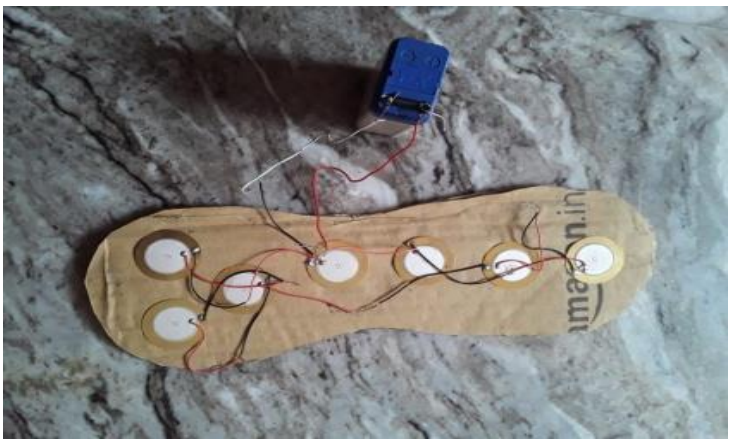
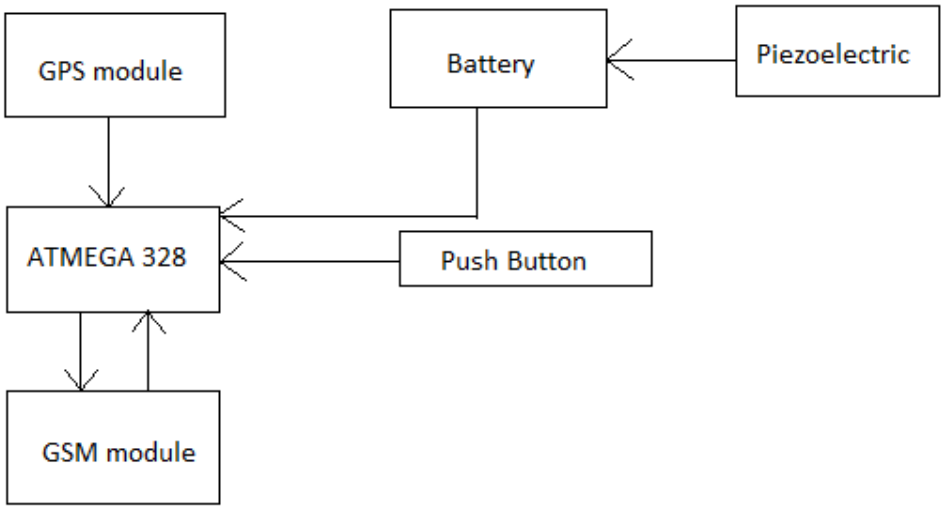


Figure 1- Piezoelectric combination

Left leg shoe- Left leg shoe consists of an Arduino Nano, GPS NEO-6M, GSM 800L and a 3.7V

battery. As soon as victim will press the button, the circuit starts working and the GPS finds the location and immediately send it to the 5 predefined numbers using the GSM. The information regarding the location with alert message helps the family of the victim to save her. The best thing of this shoe is that the whole process will run secretly and attacker can't notice anything. The block diagram of the left shoe circuit is shown below.



Left shoe tracker circuit block diagram

The block diagram shown above states that GPS module only sends the signal to the Arduino and GSM module both transmits and receives the signal to the Arduino. The push button is connected with the ATMEGA 328. The power supply pin is connected to the Arduino and provides supply to the whole setup. Piezoelectric recharges the battery while walking.

3. Result

This device is good for safety purpose. This device is not only helping the victim but saves the energy too as piezoelectric sensors are working that make the batteries used in the device to recharge timely. Shock circuit is producing high voltage and gives the best result, so that attacker hurts the most. There is no need of extra space to carry this device because this is inbuilt in shoes. The whole system is working successfully with 4V batteries and shoes with the circuits are comfortable to wear.

4. Conclusion

We have now made a project that is very helpful for safety purpose. Women can go anywhere without any fear. It gives them freedom and strength to face the attacker. It is cost effective and can easily reach to common people. It makes the family member of the victim stress free and they can easily reach to her by tracking the location. The true potential of this project lies in the future when IOT makes its place everywhere in India.

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A CASE STUDY ON LIME ROAD COMPANY USING VARIOUS TRANSPORTATION METHODS

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Abstract

This paper report mainly focuses on India's urban and rural transportation problems. India is a country where the urban population is about 17.1% to 29.2%. Meanwhile, the rural population is nearer to 82.9% to 67.2%. Summed, the urban population is 34.93% whereas the rural is 67.07% according to a survey in 2020. The major goal of a transportation challenge is to find an initial basic workable solution. In this paper we model the distribution of Lime road products as the transportation problem. In this paper, we have taken the firm that has to deliver the goods in the best possible way and the way is described here. We will be solving the problem to earn maximum returns with unexacting possibilities. The primary motive is to produce such an amount that the transportation become much flexible and easy to accommodate with more benefits and tremendous outputs.

Keywords:- *transportation problems, transportation challenge, Vogel-Approximation Method*

1. Introduction

Transportation problem is a special programming arrangement that is linked to everyday activities in our world and is more concerned with planning. To satisfy indicated necessities, items are moved from an assortment of sources (e.g., a handling office) to an assortment of areas (e.g., a stockroom). Overall, transportation challenges are associated with the movement of a single item made from numerous plants (supply starting) to various locations (wanted areas).

The issue is that commodities are transferred from one location to another at the lowest possible cost of shipping or travel. Highway, rail, water, pipeline, and air transportation are all examples of infrastructure. These can be classified as well. Automobiles, buses, lorries, motorcycles, bicycles, and pedestrians all use highways. Cargo and passenger transportation, as well as city and inter-city transportation, can all be classified. Public (or major) transportation (bus, rail, commercial air) and private transportation are the two types of passenger transportation (car, taxi, regular plane).

2. Objective

In this paper we model the distribution of Limeroad products as the transportation problem. We have taken here the firm that has to deliver the goods in the best possible way and the way is described here. We will be solving the problem to earn maximum returns with unexacting possibilities. This contains a problem which is to be lessened to get the best outcome out of it. The transportation is done in such a manner that the problem is solved to confer with the cost which is more convenient to the consumers.

3. Problem Statement

There is an organization named Lime Road. It is an Indian internet-based Marketplace. It is India's most memorable ladies' social shopping site. It bargains in attire and embellishments for ladies, men, and children. It's a style and way of life E-business organization. There is a request for such items (Sarees, Tops, Shirts) from the better places (Moradabad, Delhi, Noida, Khurja) as shown in Table 1 and the organization needs to convey those things so that the absolute transportation cost is limited. Let's glance at the issue in the table beneath:

Table.1

	D_1 (Moradabad)	**Delhi(D_2)**	**Noida(D_3)**	**Khurja(D_4)**	**SUPPLY**
Saree(S_1)	11.00	13.00	17.00	14.00	250.00
Tops(S_2)	16.00	18.00	14.00	10.00	300.00
Shirts(S_3)	21.00	24.00	13.00	10.00	400.00
DEMAND	200.00	225.00	275.00	250.00	

The observation expected:

•To show the conveyance of LIMEROAD items as a transportation issue.

•To limit the cost of transportation.

3.1. Different strategies of transportation problem

Any of the following strategies can be used to achieve this initial fundamental solution:

(i) North-West Corner

(ii) Minimum(Least Cost) Matrix Method

(iii) Vogel-Approximation Method

(i) Northwest Corner rule (NWC)

The Northwest Corner Method (or upper left corner) is a heuristic strategy that ensures that a first possible arrangement exists for a particular sort of Linear Programming issue structure known as the Transportation Model. The way starts at the cell (course) in the northwest corner.

North West Corner Method of allocation

Step 1: Fill in the highest possible value in the selected cell and subtract it from the relevant supply and demand value.

Step 2:Exit and skirt the line or section where the proposition or necessity approaches zero, showing that you will not be able to share anything more in that column or segment. In the event that a line or segment approaches 0 simultaneously, avoid only one (line or section) and leave zero stock (need) in the leftover column (segment).

Step 3: Take a breather if only one line or column is missing. If the column has just been detached, shift to the right-hand cell; if the row has just been disconnected, move to the bottom cell. Step 1 should be continued.

Solution of Table.1 by Northwest Corner Rule

	D_1	**D_3**	**D_3**	**D_4**	**SUPPLY**
S_1	19.00	30.00	50.00	10.00	7.00
S_2	70.00	30.00	40.00	60.00	9.00
S_3	40.00	8.00	70.00	20.00	18.00
DEMAND	5.00	8.00	7.00	14.00	

The values for S1 = 7 and D1 = 5 are equate.

Minimum of two minutes (7.5) = 5 allocate to S1 D1

This linkup the full D1 requirement and left 7 - 5 = 2 unit and S1.

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00(5)	30.00	50.00	10.00	2.00
S_2	70.00	30.00	40.00	60.00	9.00
S_3	40.00	8.00	70.00	20.00	18.00
DEMAND	0.00	8.00	7.00	14.00	

The values of S1 = 2 and D2 = 8 are equate. The minimum of 2 min (2,8) = 2 are allocated to S1 D2 This eliminates the dimension of S1 and left 8 - 2 = 6 unit and D2.

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00(5)	30.002)	50.00	10.00	0.00
S_2	70.00	30.00	40.00	60.00	9.00
S_3	40.00	8.00	70.00	20.00	18.00
DEMAND	0.00	6.00	7.00	14.00	

The values for S2 = 9 , D2 = 6 are equate.
Minimum of 2 minutes (9.6) = 6 allot to S2 D2
This matches the total requirement for D2 and left 9 - 6 = 3 units and S2

Repeat this process until all the rows and columns are not allotted.

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00(5)	30.00(2)	50.l00	10.00	7.0
S_2	70.00	30.00(6)	40.00(3)	60.00	9.00
S_3	40.00	8.00	70.00(4)	20.00(14)	18..00
DEMAND	5.00	8.00	7.00	14.00	

The final transportation cost=19×5+30×2+30×6+40×3+70×4+20×14=1015

So, the number of cells assigned = 6 = m + n - 1 = 3 + 4 - 1 = 6 ∴ Theanswer is non-degenrate.

(ii) Least cost (Minimum Cell) Method

The least-cost technique is a transportation issue solution in which we choose the smallest element in each transportation problem, evaluate supply and demand, and then determine the minimal supply and demand need. It's another approach to discover the first feasible transport table solution.

Least Cost Method of Allocation

Step1-Conclude the base cost in coast framework of the entire vehicle table let it be cij. Allocation $x_{ij}=\min(a_1, b_1)$ in the cell i, j.

Step2-If $x_0=a_i$, cross out the ith line of the table of transportation and decline artificial intelligence by bj.

Step3-Repeat stage 1 and stage 2 for the subsequent diminished transportation table until every one of the prerequisites are fulfilled at whatever point the base expense isn't interesting go with an erratic decision among the base.

Solution of Table A by Least coast method

The minimum shipping rate is 8 cells in S3D2. The distribution of the cell is min (18,8) = 8. This fulfils all D2 requirements and left 18 - 8 = 10 and S3 unit.

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00	30.00	50.00	10.00	7.00
S_2	70.00	30.00	40.00	60.00	9.00
S_3	40.00	8.00(8)	70.00	20.00	10.00
DEMAND	5.00	0.00	7.00	14.00	

The minimum transport cost is 10 in cell S1D4. Distribution of cell is in 7,14) = 7.
This eliminates the demand of S1 and left 14 - 7 = 7 unit and D4.

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00	30.00	50.00	10.00(7)	0.00
S_2	70.00	30.00	40.00	60.00	9.00
S_3	40.00	8.00(8)	70.00	20.00	10.00
DEMAND	5.00	0.00	7.00	7.00	

Minimum transportation price is 20 cell S3D4.
Distribution of this column is min (10,7) = 7.
This fulfil all D4 requirements and leaves 10 - 7 = 3 and S3 units.

Continue this process.

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00	30.00	50.00	10.00(7)	0.00
S_2	70.00(2)	30.00	40.00(7)	60.00	0.00
S_3	40.00(3)	8.00(8)	70.00	20.00(7)	0.00
DEMAND	0.00	0.00	0.00	0.00	

Initial feasible solution is

	D_1	D_3	D_3	D_4	SUPPLY
S_1	19.00	30.00	50.00	10.00(7)	7.00
S_2	70.00(2)	30.00	40.00(7)	60.00	9.00
S_3	40.00(3)	8.00(8)	70.00	20.00(7)	18.00
DEMAND	5.00	8.00	7.00	14.00	

Final transportation price =10×7+70×2+40×7+40×3+8×8+20×7=814
So, the no. of cell allocation = 6 = m + n - 1 = 3 + 4 - 1 = 6.
So this is non – degenerate.

(iii) Vogel's Approximation Method (VAM)

Vogel's Approximation Method (VAM) is a method for detecting the first possible transportation difficulty. The Vogel Approximation Method improves on the tiny coastal route. This is a heuristic solution that is extremely near to being perfect. VAM frequently finds the best or very close to the first appropriate solution to a small-scale transportation challenge. This method considers the cost of allocation as well. Using this heuristic involves five steps:

Step 1: In all rows and columns, including dummies, find the differences between the two lowest

cells.

Step 2: Figure out which line or section has the best contrast. Bonds can be consequently broken.

Step 3: As much as achievable to the most economical cell in the line or area with the best differentiation. If something like two aberrations are equivalent, give the most to the cell in these lines or segments with the least worth.

Step 4: When all of the line and column criteria have been satisfied, stop the procedure. Otherwise, proceed to the next step. Step 5: Calculate the difference between the two numbers again.

Solution of table A by Vogel's Approximation Method

The initial VAM allocation

	D_1	D_3	D_3	D_4	SUPPLY	Row penalty
S_1	19.00	30.00	50.00	10.00	7.00	9.00=19-10
S_2	70.00	30.00	40.00	60.00	9.00	10.00=40-30
S_3	40.00	8.00	70.00	20.00	18.00	12.00=20-8
DEMAND	5.00	8.00	7.00	14.00		
Column Penalty	21=40-19	22=30-8	10=50-40	10=20-10		

Column D2 has the maximum penalty, which is 22. In that column, the smallestcij is c32 = 8. Min(18,8) = 8 is the maximum cell allotment. It meets D2's demand and reduces S3's supply from 18 to 10 (18 - 8 = 10).

	D_1	D_3	D_3	D_4	SUPPLY	Row penalty
S_1	19.00	30.00	50.00	10.00	7.00	9.00=19-10
S_2	70.00	30.00	40.00	60.00	9.00	20.00=60-40
S_3	40.00	8.00(8)	70.00	20.00	10.00	20.00=40-20
DEMAND	5.00	0.00	7.00	14.00		
Column Penalty	21=40-19	-	10=50-40	10=20-10		

In column D1, the maximum penalty, 21, is listed.

In this column, the smallest cij is c11 = 19.

The cell's maximum allocation is min (7, 5) = 5. It meets D1's demand while reducing S1's supply from 7 to 2 (7 - 5 = 2).

	D_1	D_3	D_3	D_4	SUPPLY	Row penalty
S_1	19.00(5)	30.00	50.00	10.00(2)	0.00	-
S_2	70.00	30.00	40.00	60.00(2)	7.00	40.00
S_3	40.00	8.00(8)	70.00	20.00(10)	0.00	-
DEMAND	0.00	0.00	7.00	0.00		
Column Penalty	-	-	40.00	-		

Row S2 has the highest penalty, 40.

c23 = 40 is the smallest cij in this row.

In this cell, the maximize allocation is min (7, 7) = 7. It satisfies S2 supply and D3 demand.

	D_1	D_3	D_3	D_4	SUPPLY	Row penalty
S_1	19.00(5)	30.00	50.00	10.00(2)	7.00	9|9|40|40|--|
S_2	70.00	30.00	40.00(7)	60.00(2)	9.00	10|20|20|20|20|40|
S_3	40.00	8.00(8)	70.00	20.00(10)	18.00	12|20|50|-|-|-|
DEMAND	5.00	8.00	7.00	14.00		
Column Penalty	21 21 - - - -	22 - - - - -	10 10 10 10 40 40	10 10 10 50 60 -		

The total minimum travel cost is =195+102+407+602+880+2010=779 m + n - 1 = 3 + 4 - 1 = 6 is the no. of cells assign in this case. The answer is hence non-degenerate.

4. Applications of transportation problem

(i) Reduce shipping costs

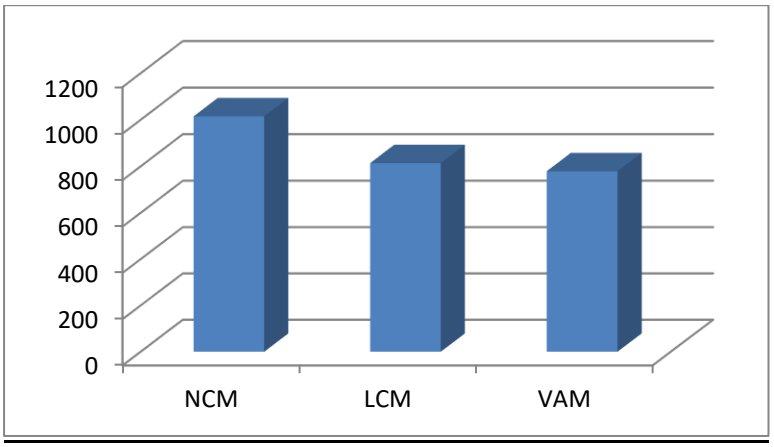
(ii) Inspect certain place

(iii) Find a schedule of small cost

(iv) Distributional army system

(v)Financial management

Comparison graph



So, based on the situation, we can see that employing the Transportation problem provides the best answer to the problem. This solution is the most cost-effective.

5. Conclusion

In profoundly cutthroat market, numerous firms strive to provide items to clients at a low cost and

in a timely manner in order to keep the market competitive. The transportation model gives a powerful framework for evaluating the best ways to get items to a consumer to fulfill this difficulty. Shipping expenses are an integral aspect of any company's total cost structure.

To discover the best solution, the transportation problem was built as a Direct System and tackled utilizing typical LP solutions like the Management Science module.

The calculations revealed a tiny amount of transportation expenses as well as the need of making flexible qualifying determinations. I excellent solutions have offered vital information such as the LIMEROAD Pvt sensitivity analysis. Ltd to make the proper judgments after addressing LP problems using a computer program.

The ATM distribution system (ATM) is a novel way for finding the first viable solution to travel difficulties that is discussed in this article. The efficiency of the distribution table technique was examined by addressing a certain amount of cost to minimize transportation difficulties, and it was discovered that the distribution table strategy delivers a nearly improved outcome.

By utilizing this Transportation Model, a company (lime road) may quickly and simply identify its transportation plans, allowing it to not just minimize the cost of carrying products and services, yet in addition to save time by gaining timely access to goods and services.

Finally, the distribution table technique can be stated to give a remarkable basic feasible solution by assuring minimum trip expenditures. Those that seek to optimize their earnings by lowering travel costs will benefit from this.

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STUDY ON REDUCTION OF WAITING TIME USING QUEUING THEORY

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Abstract

In a health care system, a long waiting time can be attributed to lack in the management of the system. This paper focuses on a wide range of queuing theory in these areas. Average waiting time in line, average time spent in the system, average length of the line, average number of individuals in the system, traffic intensity. The main objective is to decrease the waiting time of patients and to increase the efficiency of the clinic. On the basis of exponential service rate and first-come, first-served policy, it also takes the clinic into account as a server queuing system after Poisson arrival. In the end, it was determined that to accommodate the number of patients visiting the clinic, there is a need to expand the number of employees there. Additionally, the staffing plan needs to be created based on the pattern of patients during the working days.

Keywords: *Queuing theory, waiting time, traffic intensity, Poisson arrival*

1. Introduction

The largest issue patient face while visiting a medical facility is queuing up. Health is a major concern in today's stressful world. Due to the lower cost of care in government hospitals compared to private clinics, many choose government hospitals over private clinics, making this problem more devastating (Malik and Belwal, 2013). Since no known society is immune to the issue of queuing, queuing has been the focus of scholarly discussion. Queuing is expected to occur wherever there is rivalry for scarce resources. Thus, implementing queuing theory in the healthcare industry is essential for enhancing systems and raising the standard of treatment. Numerous studies have demonstrated the application of queuing theory in healthcare. In 1976, Mc Clainexamines research on methods for assessing how bed assignment rules affect patient turn-away risk, waiting times, and usage. In 2001, Nosek and Wilson analyze the implementation of the queuing theory in the pharmacy industry with a focus on enhancing client satisfaction. By anticipating and lowering wait times and modifying workforce, customer happiness is increased. In 2002, Preater provides a brief overview of the application of queuing theory in the field of healthcare. In 2006, Green used the queuing theory in the healthcare industry. The basic M/M/S concept, its underlying

presumptions, and its expansions are covered, as well as how the theory can be used to estimate the necessary number of servers. She also analyses the relationship between delays, utilization, and the number of servers required.In 1991, Taylor and In1993, Callahan, as well as numerous others, have taken advantage of the queuing theory in a variety of health maintenance settings, includinganalysis of utilization and processing times, programming model, Outpatient appointment systems, appointment schedulers, the urgent heartin-patient stream, among individuals. They were successful in demonstrating how queuing theory may be used in the healthcare industry.

Queues are a significant problem for all healthcare systems. In the industrialized world, a lot of research has been done on how to make queuing systems in different public hospital settings better. Unfortunately, certain nations are falling behind. By examining the line-up scenario in healthcare facilities in a public healthcare and bringing its practical significance to how decision-making might be improved in public hospitals, this study aims to contribute to the discussion on this topic.

2. Research Methodology

Single channel queuing system

Look at a single server queuing system (M/M/1) where clients arrive according to a Poisson's process with a rate λ, and services are provided according to an a rate-dependent exponential distribution μ. Consumers are designated as victims who are arriving here. We presume that each phase's services are separate and identical, and that only a victim is ever present inside the system of service at once. Once a client logs into the system, if it is free at that moment, his or her service time begins immediately; otherwise, the client joins the line and waits for their turn or service number. If there are no additional extended service facilities available after the patient's services are finished, they are released from the queue. Arriving patients go into orbit and become a source of recurrent calls if the server is busy. This collection of sources for repeated calls could be thought of as a kind of queue. Every patient's wait time is an exponentially distributed variable with the parameter μ below is a visual illustration of a single server queuing model (m/m/1) showing a line of patients waiting for the server to become available to serve them. There is virtually little chance that patients who arrive at the conclusion of a medical system that is overloaded with people would receive treatment because there is only one server providing services. In the worst case, patients can be turned away from the system.

3. Model Assumptions

The following presumptions are the basis of this research.

a) The results of an investigation conducted in single unit of clinical wellness center must hold true for another units.

b) The organization structure of the medical center is practically part of the routine to the patients.

c) Alternatively, the space between two successive visitors and both time service and exponential distribution are used. Both the service rate and the patient arrival time to the queue are consistent with a Poisson distribution.

d) The method of queuing ensures that the initial victim arrives to the client when it is prepared to provide the facility.

4. Model Variables

i. Traffic Volume (utilization coefficient)

It is determined by dividing the average arrival rate λ by the average service rate μ, i.e.,

$$\rho = \frac{\lambda}{\mu} \qquad (1)$$

The appearance of victims will be high, when λ is greater. the server will effort more and line will lengthy. In the opposite, if value of λ is less, line would be smaller however in this scenario the system will see less use. If the system's expected rate of client arrival were to be higher than the expected pace of service i.e.,$\lambda > \mu$ then ρ > 1it means that because the system's capacity is less than the number of clients entering, the queue's size has expanded. The average service rate in this queueing system is higher than the average arrival rate i.e., $\mu > \lambda$

ii. Average Queue Waiting Time

The estimate amount of time a patient must wait in line before receiving service is balance to estimate amount of time a victim must wait in line. The formula is

$$W_q = \frac{\rho}{\mu(1=\rho)} = \frac{\lambda}{\mu(\mu-\lambda)} \qquad (2)$$

iii. Estimates Time Spent in System

The overall amount of time a patient spends in a system, including waiting time and facility time, is considered the average amount of time invest in a system (receiving service in a line).The formula is

$$W_s = \frac{1}{\mu(1-\rho)} = \frac{1}{\mu-\lambda} \quad (3)$$

iv. Estimated Number of Victims in the System

The estimate number of clients in system is the same as the estimate client on the server or line. It is defined as

$$L_s = \frac{\rho}{1-\rho} = \frac{\lambda}{\mu-\lambda} \quad (4)$$

v. Average Queue Length

The mean number of patients in the queue makes up the length of the average line.It is defined as

$$L_q = \frac{\lambda.\lambda}{\mu(\mu-\lambda)} \quad (5)$$

5. Analysis

From Table 1, 165 patients (21.1%) spent less than 30 minutes in the line before seeing the physician, 288 patients (39.3%) spent 30-60 minutes, 124 patients (17%) spent 1-2 hours, 80 patients (11%) spend 2-3 hours, 55 patients (7.5%) spent 3-4 hours, 25 patients (3.1%) spend 4-5 hours and 5 patients (0.6%) spent 5 hours and above.

Table 1: Time consumed in the line

Time spent on the queue	Number of patients	Percentage
0 – 30 minutes	155	21.1%
30 – 60 minutes	288	39.3%
1 – 2 hours	124	17%
2 – 3 hours	80	11%
3 – 4 hours	55	7.5%
4 – 5 hours	25	3.5%
More than 5 hours	5	0.6%
Total	**732**	**100%**

6. Results

Table 2: Determining the queuing parameters

Parameters	
Arrival rate of patient (λ) per min	2.0333
Service time per server (μ) per min	2.2277
W_q	4.6958
W_s	5.1440
L_s	10.4593
L_q	9.5480
ρ	0.9127

In the local healthcare facility, where doctors are handled as a single server, the applicability of the queuing theory is demonstrated using a single carrier queuing system. The study is based on actual observable data that was gathered from 732 patients over the course of one service week. The result in Table 2 shows that the average service rate of patients is slightly higher than the mean arrival rate, which suggests that the waiting line would develop less frequently, reducing the amount of time patients spend in line. Additionally, it is clear that there is always a line of patients waiting to be treated at the clinic because the average time spent there (both in line and receiving care) is longer than the average time spent waiting to be treated. Last but not least, throughput shows that the health center has a line but is not jammed.

7. Concluding Remarks

In this investigation, it was found that patients in the clinic must wait an extremely long period before receiving care, potentially harming emergency patients. Additionally, a patient waiting on the doctor who may be performing surgery on another patient who had an earlier appointment is the cause of the congestion. It was suggested that the traffic may be lessened by either assigning a second doctor to perform the patient's initial examination or by allowing the doctor, who serves as the sole server, to set the number of clients for the day. Our findings show that the typical time spent at the clinic is longer than the average amount of time spent waiting for treatment.

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CASE STUDY ON JOB SEQUENCING & SCHEDULING ALGORITHMS

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Abstract

Job sequencing is a process in which a machine or number of machines performed a task in a particular order. In term of selection in appropriate ways in which number of jobs can be allotted in a exact or finite number of facilities (machine) so it's output can reduce the cost and time and maximize the profit. Scheduling issues progress in various areas like Industries, roller bearing industries, textile industries, building construction, transportation, healthcare, hospitals, computer programming, and production planning and so on. Sequencing word indicates the deciding what order the jobs are to be processed on different machines. Scheduling is the process of creating a schedule that specifies the beginning and ending times of tasks for machinery, workers, etc. Resources are known as machines and task is known as operation (Job). The time variation method, a novel adjusted heuristic technique, is used to identify the required task sequence, and the normal procedure as shown in the examples above is also used to estimate the minimum total elapsed time for this sequence of jobs. The issues also offered an explanation for how N jobs were processed on 2 machines, N jobs were processed on 3 machines and N jobs M machines.

Keyword: *Job sequencing, Time variation method*

1. Introduction

Job sequencing is a process in which a machine or number of machines performed a task in a particular order. In term of selection in appropriate ways in which number of jobs can be allotted in a exact or finite number of facilities (machine) so it's output can reduce the cost and time and maximize the profit.

This technique address the issue of rebuilding the best schedule for jobs involving people, equipment, resources, structures, and other possible resources that are necessary to encourage the production sequence. Minimization of total elapsed time of time between the finishing the first job and last job in appropriate sequence is the main aim of this technique. This technique used the cost effective resources and gives the high profit and low cost. Another purpose of this technique is minimize the customers waiting time for getting the product, and delivered in promised time etc.

Scheduling issues progress in various areas like Industries, roller bearing industries, textile

industries, building construction, transportation, healthcare, hospitals, computer programming, and production planning and so on. Sequencing word indicates the deciding what order the jobs are to be processed on different machines. Scheduling is the process of creating a schedule that specifies the beginning and ending times of tasks for machinery, workers, etc. Resources are known as machines and task is known as operation (Job). The setting of the scheduling issue is referred to as the shop. Different types of shops are used in scheduling issues like open shop, missed shop etc.

Distinct items are produced in manufacturing enterprises by processing raw materials using various machinery. In many industries, the way that jobs are organized and processed varies. Job shops, cellular manufacturing, project shops, continuous manufacturing, flow lines, flexible manufacturing, and modular production system are some examples of the best handling areas. The planning of jobs, which depends on the characteristics of the goods, the length of the lot, the transfer of resources and resource, and the application of intangible functions like production schedule, process planning, stock control, and supply chain management, is essential to the effective use of the manufacturing facility.

2. Terminology and notations

- **Machine's number** - It indicate the facility service that a task must transit through before it is finished.
- **Order of Processing -**It indicate the order in which machines need to complete the job.
- **Time of processing** – It refers to the time taken by each and every job on each and every machine. It is denoted by T_{ij}.

  Where i = time processing

  j = machine (i = 1, 2 …n; j = 1, 2 …m)
- **Idle time of a machine –** It is the amount of time in which a machine is unattended over the entire period of time. The symbol xij can be used to indicate the idle time of jth machine between the end of the $(i-1)^{th}$ job & the starting of the i^{th} job.
- **Final elapsed time –** Total elapsed time shows the time b/w the initial and completion of first and last job. Idle time is also include in this. It is denoted by T.
- **No passing rule-** Passing is not allowed in job sequencing. Order of the job is maintain in every machine.

Principle assumptions

- No machine is capable of handling more than one operation concurrently.
- Each procedure must be finished after it has been started.
- Before every subsequent operation that it must precede can start, each operation must be finished.
- The processing intervals are independent of the sequence in which the operations are carried out. Only one kind of machine exists.
- As soon as feasible, a job is processed, subject to ordering specifications.
- Before the beginning of the period under examination, all jobs are identified and prepare to initiate processing.
- The amount of time needed to transfer a job between machines is minimal**.**

3. Object of job sequencing

In this technique, purpose is that to optimize (minimize) the cost and time taken by any machine by informing a manufacturing facility when to produce, with which personnel, using which tools. The main aim of job sequencing is to maximize the profit. Numerous job scans must be processed close to additional workstations due to the dynamic environment necessitated by the business organization as an open system. If the order of the jobs is not carefully planned and handled, there could be delays, time waste, several jobs hanging, and waiting lineups.

Johnson's method or efficient optimal

In 1954, S. M. Johnson was the first to create an effective solution to flow shop scheduling issues involving tasks two and three machines. It is very simple method to find the optimum solution. This method is only for 2 or 3 machines. When one of this condition must be satisfy.

Conditions of Johnson's method are- : Johnson's condition for 2 machines: if set of the independent jobs (1, 2, 3, 4……) are processed on 2 machines "M1" & "M2" with processing times one (1) and two (2) respectively, where m = 1 then, minimum processing times of jobs on first machine M1should be greater than or equal to the maximum processing times of jobs on the 2nd machines M2.(1) ≥ (2).

Johnson's requirements for three devices: These three machines, "M1," "M2," and "M3" process a group of separate jobs (1, 2, 3, 4…) with processing times of 1, 2, and 3 accordingly. Johnson's rule will be applicable if one of the two scenarios involving the three machines that make up his condition is satisfied.

Two cases are follows in job sequencing

Case 1: Minimum processing time of job on 1st machine M1 must be greater than or equal to maximum time processing of job on 2nd machine M2. (1) ≥ (2)

Case 2: Minimum processing time of job on 3rd machine M3 be greater than or equal to maximum time processing of job on 2nd machine M2. (3) ≥ (2)

If one of the condition is satisfy then we convert 3 machine scheduling problem in to 2 machine scheduling problem. Then apply the Johnson's method to solve the problem.

Types of job sequence

There are 4 types of job sequencing.

1) N Jobs with 2 Machines
2) N Jobs with 3 Machines
3) N Jobs with m Machines
4) 2 Jobs with m Machines

Johnson's Method is used to solve the first three problems, while the Graphical Method is used to solve the fourth problem.

Sequencing n jobs in 2 machines

Suppose there are n jobs and each job is processed by 2 machines, (say A & B). Each job is handled in a predetermined sequence AB, It means each job firstly go in to machine A and then go in to machine B. To put it another way, passing is prohibited. The i_{th} job's actual or estimated processing times on machines A and B, respectively. where n=1, 2, 3, ……, n.

Suppose Each of the 2 machines A & B should process 5 jobs in the order AB, and the processing times are.

JOB	PRINTING(A)	BINDING(B)
1	5	2
2	1	6
3	9	7
4	3	8
5	10	4

Step 1:

To make the sequence, first draw the table of 5 columns (2 4 3 5 1)

Firstly, check the minimum time hour of a & b which is 1 which is exist in job 2 of machine a.

allot the job 2 in the left side of the sequence. Again check the minimum time hour which is 2 in machine B, then allot in right side of the sequence. Repeat this step again and again until all the jobs are not allotted in the sequence.

Step 2:

Draw the sequence table to calculate the elapsed time.

Jobs	Time for machine A		Time for machine B	
	Time In	Time Out	Time In	Time Out
2	0	(0+1) = 1	1	(1+6) = 7
4	1	(1+3) = 4	7	(7+8) = 15
3	4	(4+9) = 15	15	(15+7) = 22
5	13	(13+10) = 23	23	(23+4) = 27
1	23	(23+5) = 28	28	(28+2) = 30

Total elapsed time = 30

Idle time for machine A = (30-28) = 2 hours.

Idle time for machine B = 1+ (7-7) + (15-15) + (23-22) + (28-27).

=1+0+0+1+1

=3 hours.

Sequencing n jobs in 3 machines

Only 3 machines—A, B, & C—can be used to describe the issue. Transfers of jobs are prohibited for each work that is specific to the orders A, B, and C, and processing times are provided for each machine, thus the following requirements apply.

1) The min time of A ≥ the max time of B.

2) The min time of C ≥ the max time of B.

Then covert 3 machine problem into 2 machines

Problem:

Let us take 5 jobs in which we must go through machines A, B, C respectively.

Jobs	Time for machine A	Time for machine B	Time for machine C
1	8	5	4
2	10	6	9
3	6	2	8
4	7	3	6
5	11	4	5

Solution:

Step 1: Check the condition, Minimum time of A ≥ Maximum time of B.

Minimum time of C ≥ Maximum time of B.

	1	2	3	4
A	8	7	6	9
B	6	7	5	4
C	3	5	6	4
D	4	6	7	3
E	10	11	9	7

Here the minimum time of A is 6 and the maximum time of B is 6. Both the timings are equal then condition is satisfy.(one of the condition should be satisfied).

Step 2: convert 3 machines into 2 machines.

Jobs	G = A+B	H = B+C
1	13	9
2	16	15
3	8	10
4	10	9
5	15	9

To make the sequence:

Verify the minimum time hour in G & H, that is 8 in the task 3 (box) for machine G assigned to time G. Check machine H's minimum time once more; it is 9. Since there are 3 times 9 in distinct jobs, we can create multiple sequences if we take 9, which is the minimum time for machine H assigned to job 1 (box) for time H. For every job, repeat this procedure. and creating a lot of sequences. [3 2 5 4 1], [3 2 5 1 4] and so on.

Job	**Time of machine A**		**Time of machine B**		**Time of machine C**	
	Time in	**Time out**	**Time in**	**Time out**	**Time in**	**Time out**
3	0	0+6=6	6	6+2=8	8	8+8=16
2	6	6+10=16	16	16+6=22	22	22+9=31
5	16	16+11=27	27	27+4=31	31	31+5=36
1	27	27+8=35	35	35+5=40	40	40+4=44
4	35	35+7=42	42	42+3=45	45	45+6=51

Total elapsed time = 51 hours.

Idle time for A machine = (51-42) = 9 hours.

Idle time for B machine = [6+(16-8)+(27-22)+(35-31)+(42-40)+(51-45)]

= [6+8+5+4+2+6]

=31 hours.

Idle time for C machine = [8+ (22-16) + (31-31) + (40-36) + (45-44)]

= [8+6+0+4+1]

= 19 hours.

Sequencing n jobs into m machines

There are 5 machines and 4 jobs – A, B, C, D & E and the order is A, B, C, D and E. processing time is given in the table. Evaluate the optimum sequence of jobs, elapsed time and idle times of all machines.

JOBS

Xi = (Ai+Bi+Ci+Di)
Yi = (Bi+Ci+Di+Ei)

Machines

	1	**2**	**3**	**4**
Xi	21	25	24	20
Yi	23	29	27	18

Optimum Sequence

X | 1 | 3 | 2 | 4 | Y

Job seq	A			B			C			D			E		
	In	Out	Idle	In	Out	Idle	In	Out	Idle	In	out	Idle	In	Out	Idle
1	0	8	0	8	14	8	14	17	14	17	21	17	21	31	21
3	8	14	0	14	19	0	19	25	2	25	32	4	32	41	1
2	14	21	0	21	28	2	28	33	3	33	39	1	41	52	0
4	21	30	0	30	34	2	34	38	1	39	42	0	52	59	0

Idle time of A: 59-30=29

Idle time of B: 59-34+12=37

Idle time of C: 59-38+20=41

Idle time of D: 59-42+22=39

Idle time of E: 22

Total elapsed time= 59

4. Future scope

- To reduce the average waiting time, we have primarily concentrated on various scheduling techniques. To reduce the average task unit completion time, we have also used simulation toolkit. Therefore, a different scheduling strategy could be used to reduce waiting times. Finding out if

any alternative queuing models can be used for large-scale computation is another subject that needs further investigation.

- The growing number of servers and their associated cost per service are additional possible factors to take into account. The simplest method for reducing the average waiting time is to increase the number of host machines or the server capacity. However, doing so would raise the price, which would lower the profit margin. Finding an ideal circumstance, where customer satisfaction and organizational profit are in an equilibrium state, is therefore a difficult problem. Future studies may help to verify and enhance the simulation scenario in order to calculate the cost per memory unit, cost per storage unit, etc.
- We discovered that the goal of a sequencing problem is to find the order in which jobs now in progress should be processed to reduce the overall processing time.

5. Conclusion

The required work sequence is thus obtained using the new modified heuristic strategy known as the time deviation method, and the minimum total elapsed time is likewise determined for this sequence of jobs using the standard procedure as given in the examples above.

The problems also provided an explanation for the processing of N jobs on two machines and N jobs on three machines

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HAZARDOUS WASTE AND HEALTH IMPACT:A SYSTEMATIC REVIEW OF THE SCIENTIFIC LITERATURE

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Abstract

Waste is section of the agenda of the Indian Environment and Health method and included a various types of components. Hazardous waste management and disposal are global tasks. I conduct a systematic evaluation using simple and quick decision-making techniques to quantify the evidence of the health impact of hazardous waste revelation. The subsequent five steps, which were carried out based on previously established ordered criteria, clearly explain the study topic using the terminology "Population-Exposure-Comparators-Outcomes" (PECO). People who live close to hazardous waste sites make up the population; they areexposed to hazardous waste; all comparators are used as benchmarks; and all diseases andhealth conditions are the outcomes. 2. Conduct a literature search in EMBASE and Medline. 3. Original epidemiological research on people exposed to hazardous waste in their homes, published between 1999 and 2015, were chosen for inclusion. 4. Evaluate the caliber of the research you have chosen, taking into account study design, exposure and result evaluation, and confounding control. 5. Give each outcome a confidence score based on the reliability of the studies, the degree of the link, and the consistency of the findings.

The connection between unique feature with hazardous waste in residential areas and 94 health consequences (diseases and disorders) was assessed. Domestic hazardous waste exposure has several health benefits, many of which were previously underappreciated. Finely tailored symptoms were shown to be associated try waste that emits large quantities of hydrogen sulphide. There is insufficient proof that hazardous waste causes the following health outcomes: non-Hodgkin lymphoma, asthma, congenital abnormalities in general, neural tube abnormalities, abnormalities of the urogenital, connective, and musculoskeletal systems, low birth weight. And premature birth. Even if the results are not conclusive, they do highlight the urgent need for more effective public health policies regarding the disposal of hazardous waste. Authorities at the international, national, and local levels should oppose and criminalise dangerous, unethical, and unlawful waste disposal practices, including illicit transboundary commerce, and increase regulation and its enforcement.

1. Background

The available information on the health implications of living close to hazardous waste sites has been thoroughly reviewed in this work. Our goal was to identify the supporting evidence for the link between exposure to hazardous waste and adverse health effects. One of the priority areas for the World Health Organization's member states is waste, particularly hazardous waste. Waste organisation and disposal are global problems. The disposal of hazardous waste has an impact on local populations almost everywhere; this includes unlawful international trading, primarily from industrialised nations. In middle-low income nations, the intention of diseases caused by waste-related exposures is rising but not being fully acknowledged.

The phrase "hazardous waste" is sometimes used to refer generically to non-household waste that contains harmful substances. In our search literature, we only included the terms "hazardous," "toxic," and "industrial" waste. Publications about municipal landfills, which lack records of the disposal of hazardous materials, incinerators, e-waste, and radioactive waste were eliminated. Occupational studies are not taken into account in the current evaluation. According to several assessments, the main global cause of soil and groundwater contamination is inefficient and illegal waste management. Harmful waste has been ranked among the top three key environmental risk factorsin India, where the WHO estimates that environmental risk factors account for 1/3 of theillness burden.Household and the management of hazardous waste is particularly significant.

Less than 30% of urban Landfills are used to dispose of trash in the majority of African cities. The residual garbage is dumped in unauthorised landfills. India is also a populardestination for travellers involved in the international trade of hazardous and urban garbage from industrialised nations. Exams covering a wide range of health concerns for residents in the areas around hazardous waste disposal plants have been made available in recent years. However, a current evaluation of the evidence linking hazardous waste to unfavourable health impacts is not yet accessible.

The proof of a relationship with urban waste dumps and birth defects of the neural tube and genitourinary system, as well as low birth weight, was estimated as partial for total in the literature evaluation that followed on the health effects of municipal waste management. Mattiello andcoworkers came at consistent conclusions.

To evaluate the evidence of the health effects of exposure to hazardous waste using predetermined

criteria, a systematic review is provided in this regard.

2. Methods

Recently, reputable organizations like the US EPA and WHO advised using established procedures and defined selection criteria.

According to Woodruff, a five-step procedure was used: Identify the study question in detail; 2. Conduct a literature search, describing the search technique in enough detail toallow it to be repeated; 3. Determine which research should be included by examining their adherence to predetermined criteria; 4. Evaluate the caliber of each of the chosen studies; 5. Calculate your level of confidence in the available evidence for each result Indepth.

"Population-Exposure-Comparators-Outcomes" (PECO) was used to develop the study question: People who live close to hazardous waste sites make up the population; they areexposed to hazardous waste; all comparators are used as benchmarks; and all diseases andhealth conditions are the outcomes.

3. Results

Some researchers then evaluated the abstracts of the generated papers independently using the inclusion scale. The entire investigative team went over the findings of this initial assessment. A few publications describing epidemiological studies on communitiesresiding close to dangerous desecrated sites were chosen. Finally, a few publications werechosen in addition to the assessment of the reliability of the data.

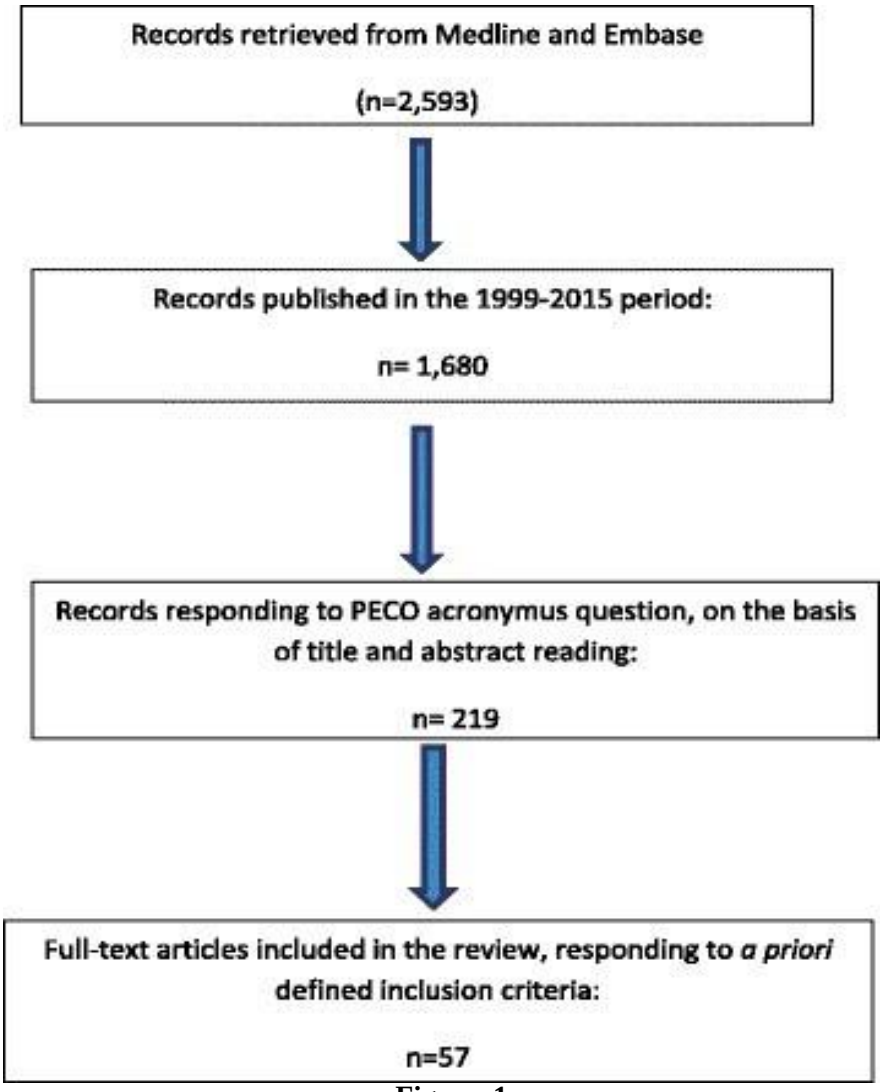

Figure. 1

Therefore, it was determined that there was insufficient evidence for all other conditions, limited evidence for liver, breast, testis, and bladder cancers, non-Hodgkin lymphoma, and asthma, general and specific congenital anomalies (urogenital, neural tube, musculoskeletal and connective system), low birth weight, and preterm birth, and no evidence for a causal relationship between exposure to hazardous waste and chronic and reproductive health outcomes.

Studies on acute effects in Abidjani residents who live close to illegal dump sites have shown enough relationship between acute general and neurological symptoms, more specifically otolaryngological, respiratory, digestive, and dermatological symptoms, after exposure to oil industry pollution.

4. Discussion

In the current assessment, research on locations where hazardous items were handled is taken into account. Due to the constraints of the exposure evaluation depending on place of residence at the time of result observation, the dependability of the bulk of the studies was rated as "moderate". Rarely was information regarding the pollutants existing at the garbage site and in the nearby residential area at the time of the study. When it was, the study wasgiven more weight. The evidence connecting severe neurological and general symptoms to exposure to oil industry waste that emits large levels of hydrogen sulphide was regarded sufficient, in particular those affecting the otolaryngology, respiratory, digestive, and skin systems. The basis for this evaluation was two cross-sectional studies carried out among the population. Furthermore, it is challenging to compare studies due to the definition of hazardous waste. Various substances can be found in hazardous waste. That have an impact on numerous environmental matrices and involve a number of exposure routes, depending on the type of garbage as well as hydrogeological and meteorological conditions. Due to these limitations, the size of the health effects is typically estimated rather than overestimated, which weakens the case for specific exposures to hazardous waste. In Abidjan, for instance, this is the situation near to the sites where 500 tonnes of hazardous trash were forcibly buried, releasing hydrogen sulphide into the atmosphere. High and moderate/high quality were assigned to the two studies, respectively. They reported increased relative risks with accuracy and regularity. The strength of the connection, the presence of a dose-response relationship, time coherence, and biological plausibility provide additional evidence for causation. Alternative explanations can be logically ruled out, particularly those involving random variability, systematic bias, and confounding variables.

Chemicals that are liver-toxic can be created artificially or naturally. These latter substances include metals, aromatic and halogenated hydrocarbons, chlorinated aromatic compounds, and nitro compounds, all of which may be present in various amounts in hazardous waste or released by it. Hepatic carcinogenicity and hepatotoxicity are related.

Our evaluation of liver cancer was based on the findings from eleven studies, some of which mentioned the occurrence of organic chlorinated compounds like vinyl chloride.

5. Conclusions

The current assessment made clear that there is enough data to support a link between exposure to oil industry waste that releases high levels of hydrogen sulphide and acute symptoms. For

malignancies of the liver, bladder, breast, testicles, and non-Hodgkin lymphoma, the evidence of a causative connection with hazardous waste was deemed limited. Asthma was discovered to have a tenuous link to hazardous waste among non- neoplastic illnesses.

These results show that improper management of hazardous waste may have an adverse effect on the health of the local people. These communities are at risk for health problems because several environmental matrices, including food, water, soil, and air, are contaminated. There is no need for more evidence; instead, prioritising management strategies and opposing illegal commerce vigorously are justified.

But in many instances, more study is required to fill in critical information gaps. Population studies that examine different exposure pathways while taking into account site characteristics and the chemicals present at each waste site in particular may be able to shed light on this. Acute respiratory conditions, diabetes, and paediatric neurological problems are of particular importance, especially in view of the strong data suggesting that ambient exposure to EDCs and suspected EDCs may cause abnormalities in human cognition and behaviour.

The findings of our analysis, while not definitive, point to the urgent need for public health regulations on hazardous waste management. Poor, out-of-date, and unlawful garbage disposal procedures should be opposed and eliminated by international, national, and municipal authorities (including illegal transboundary trade).

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COLD METAL TRANSFER BRAZING OF INTERSTITIAL-FREE STEEL

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Abstract— Load bearing capacity of a lap joint is highly influenced by the wettability of molten filler metal which in turn is dependent on the heat input i.e. process parameters. This paper presents the importance of heat input in determining the joint strength. In addition, the novel Braze+ torch was employed for the brazing of steel sheets. Optical microscope and scanning electron microscope (SEM) were employed for the characterization of microstructure of the joints. Tensile testing was performed to study the effect of intermetallic layer thickness and L/θ ratio on the joint strength. Two modes of failure (interface and parent material) were observed and the fractured surfaces were characterized using FESEM. Microhardness was also measured in order to capture the hardening of deposited filler metal via dispersion of Fe-Al intermetallic dendrites into the Cu matrix.

Keywords—*Interstitial-free steel, cold metal transfer brazing, intermetallic layer, joint strength*

1. Introduction

Automobile sector significantly influences a nation's economy. Future trends in automobiles include reduction in fuel consumption & weight, higher corrosion resistance, safety and comfort of the passengers [1]. Satisfying contradictory requirements of light weight but improved safety is a challenging task for the automobile industries [3]. But lightening of vehicles can be achieved ether by using light-weight materials like aluminium, magnesium, composites etc. or by decreasing the steel thickness by adopting high strength grades [4]. Several issues like formation of hard and brittle intermetallic compounds, spatter, wavy edges etc. are encountered when joining Al to steel due to incompatible thermo-physical & mechanical properties. Additionally, joining of thin sheets using conventional welding methods results in burn-through, distortion, zinc coating evaporation in vicinity of joint [5]. These issues can be minimized by controlling the heat input during welding. Cold Metal Transfer (CMT) process developed by Fronius provides an opportunity for joining particularly thin sheets by summing the qualities of both solid state and fusion welding [6]. The CMT process enables spatter-free joining of similar as well as dissimilar metals which can be attributed to the advance feature of wire retraction during short circuiting. Retraction of filler wire allows smooth and defect free deposition of molten filler into the weld pool along with a huge reduction in heat input in comparison to the conventional Metal Inert Gas (MIG) welding [7]. In

CMT cycle, melting of filler wire takes place in boost phase i.e. globule forms at the tip of filler wire, globule expands in the wait phase till the occurrence of short circuiting, then in short circuiting voltage is nearly zero and current is also very low. Finally molten droplet transfers to weld pool and cycle repeats again. Wire retraction during short circuiting allows the metal transfer without the aid of electromagnetic forces [8].

Extremely low heat input during short circuiting in CMT process enables it for joining thin sheets without any defect like burn-through, spatter& distortion etc. [9-12]. Zinc coated (Galvannealed) steel are being extensively used for automobiles due to their weldability and good anti-corrosion resistance [2]. In this work, CMT brazing process was applied for joining galvannealed Interstitial Free (GA-IF) steel sheets of dissimilar thickness using aluminium-containing copper-based filler wire. OFAT technique was used to investigate the effect of process parameters namely wire feed rate and brazing speed on mechanical and metallurgical properties of the joints.

2. Material and methodology

Dissimilar IF steel sheets (1.6 mm at bottom and 1.4 mm at top) with 90 gsm coating were used. CMT brazing with braze+ torch was used for brazing of lap joints with an overlap distance of 25 mm. ERCuAl wire of 1.2 mm diameter was used as the filler and pure argon (99.999%) was used as shielding gas at a flow rate of 10 l/min. The composition of base material and filler wire is listed in Table 1.

TABLE I: CHEMICAL COMPOSITION (Wt%) OF THE BASE MATERIAL AND FILLER WIRE

	C	**Mn**	**S**	**P**	**Si**	**Ni**	**Nb**	**Ti**	**Al**	**Cu**	**Fe**
IF steel	0.003	0.058	0.013	0.012	0.013	0.02	0.012	0.03	-	-	Bal.
ER CuAl8	-	0.2	-	-	-	0.5	-	-	8.0	Bal.	0.2

Brazing parameters are shown in Table 2. Schematic of the brazing process and cross-section of joint is represented in Fig 1. Actual heat input was calculated using the following equation

$$\mathrm{HI}_{actual} = \eta \times \frac{UI}{60v} \quad (1)$$

Where U is the mean voltage (Volt), I is the mean current (Ampere), v is the brazing speed (mm/min) and η is the process efficiency (η= 0.85) [13].

TABLE II: CMT BRAZING PARAMETERS USED IN THE STUDY

Parameter	**Values**

Wire feed rate (WFR)	3 to 7 m/min
Brazing speed	500, 1000 and 1500 mm/min
Work and travel angle	20º each

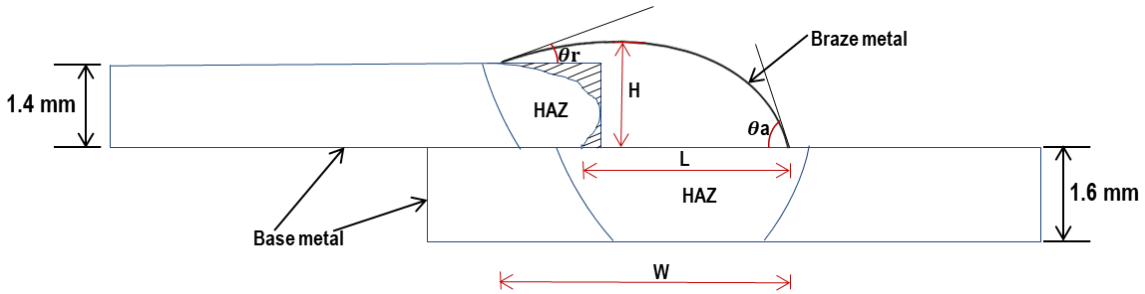

Figure. 1. Schematic diagram of cross-section of brazed lap joint

For metallographic analysis, the samples were polished using abrasive paper & diamond slurry and subsequently etched with Picral followed by 5% Nital solution. Samples were examined using optical microscope and scanning electron microscope (SEM) with energy dispersive X-ray spectroscopy (EDS) & back scattered emission (BSE) modes. Microhardness was measured under a load of 100 gf.

3. Results and discussion

Fig. 2 shows the bead at minimum and maximum wire feed rates (WFR) of 3 & 6 m/min at 500mm/min brazing speed i.e. joints brazed at minimum and maximum heat input. At low brazing speed (500 mm/min), bead was uniform for low WFR but porosity was observed. The reason for porosity could be the inability of zinc vapours to escape due to faster solidification of the deposited filler. On increasing the WFR to 6 m/min, the zinc coating damaged on the back side was excessive due to higher heat input per unit brazing length, which increases susceptibility to corrosion. Therefore, higher WFR of 7m/min for this brazing speed was not used. For faster brazing speed 1000 & 1500 mm/min, wavy edges in the beads were observed. Insufficient molten filler material per unit length per unit time could be the reason for the waviness. At the moderate speed (1000 mm/min) and higher WFR (7 m/min) spatter was also observed adjacent to the bead. At higher WFR, higher heat input along with excessive amount of molten filler material resulted in instability of molten pool and hence caused spatter. Sharma et al. [14] also observed spatter at higher heat input due to severe melting of filler wire and parent material.

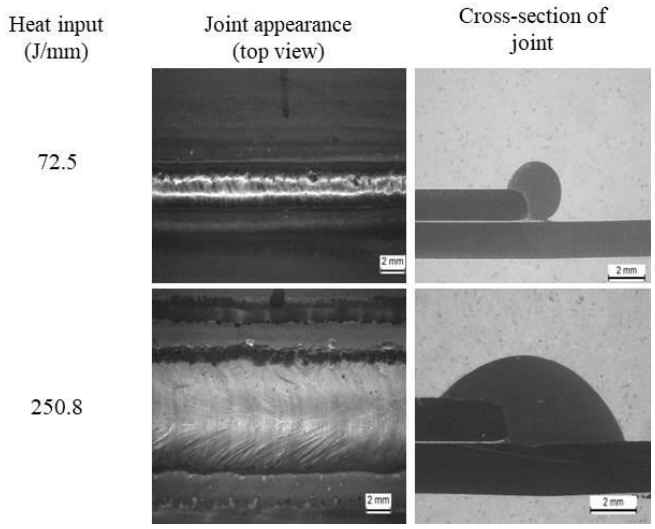

Figure. 2. Joint appearance and bead profile

Variations in bead width with brazing speed and wire feed rate are plotted in Fig. 3. It can be observed that the bead width increased on increasing the WFR for each level of brazing speed i.e. 500, 1000 & 1500 mm/min. Higher scatter was observed in bead width value at the maximum WFR (7 m/min). Generation of strong turbulence in the molten pool at the higher WFR could be the reason for the variations in bead width [14]. Maximum bead width of 8.24 mm was achieved at the brazing speed of 500 mm/min & WFR 6 m/min. As the brazing speed was increased to 1000 & 1500 mm/min, the bead width decreased significantly for all values of WFR (Fig. 3). Decrease in the bead width is due to the reduced deposition of filler material per unit length. Joining was not achieved for high speed (1500 mm/min) and low WFR (3, 4 & 5 m/min) due to insufficient heat input, which resulted in negligible wetting of steel by filler material.

To examine the wetting behavior of the molten filler material on steel surface, bead parameters e.g. height (H), wetting length (L), bead area (A), loss of parent material (BP) and contact angle (θ) were measured and are listed in Table 3. Wetting length (L), bead area (A) and loss of parent material increased on increasing the WFR while contact angle (θ) & bead height (H) decreased. Variation of bead parameters with increasing heat input assured the better wettability of deposited filler material. In this study, joining was not achieved for contact angle greater than 90°. Reisgen et al. [15] reported that contact angle should be less than 90° to achieve superior mechanical properties. A portion of the upper sheet melted during brazing and dispersed into the deposited filler metal. Melting of the upper sheet increased on increasing the heat input.

Table 3: Bead shape of the joints at different heat inputs

Sample No.	WFR (m/min)	Speed (mm/min)	HI (J/mm)	L (mm)	H (mm)	θ (deg.)	Loss of BM (sq. mm)	Bead Area (sq. mm)
1	3	500	104.58	2.41	2.53	105.7	0.24	6.75
2	4	500	145.15	3.41	2.91	89.3	0.14	9.39
3	5	500	190.7	4.26	2.68	63.01	0.35	10.84
4	6	500	250.84	4.98	2.95	62.44	0.41	13.73
6	4	1000	72.57	1.03	2.67	146	0.27	5.26
7	5	1000	95.35	2.89	2.23	63.16	0.34	5.92
8	6	1000	125.42	3.55	2.17	68.26	0.37	7.13
9	7	1000	177.44	4.21	2.36	50.47	1.61	8.39
12	6	1500	83.61	2.5	2.06	58.64	0.56	4.74
13	7	1500	118.29	3.87	1.9	47.95	0.61	6.07

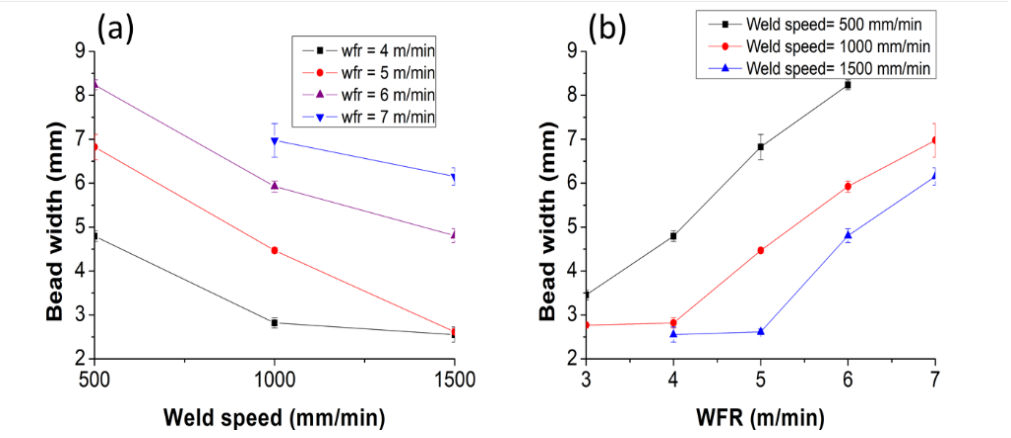

Figure. 3. Variation of bead width (a) with speed, (b) with WFR

In terms of heat input, in the present work, joining was not achieved for heat input below 72.57 J/mm, whereas coating damaged on the back side occurred for heat input above 177.44 J/mm (Fig. 2). Absence of joining below a certain value of heat input can be attributed to the insufficient inter-diffusion of Fe-Al atoms at the interface. Formation of Fe-Al intermetallic layer of certain thickness is necessary to achieve reasonable joint strength [5]. Shape and size of the intermetallic compounds can be controlled by reducing the heat input [16, 17].

Fig. 4 shows the SEM images of intermetallic layer. It can be seen that the layer is composed of tooth shaped compounds and the deposited bead is composed of dendrites (Fig. 5). Intermetallic layer was thicker at the center of the bead in comparison to the corners. Majority of the molten filler deposited at the center which led to the thickening of layer due to the associated higher heat. During brazing, edge of the upper steel melted and fine particles of Fe dispersed into the deposited filler material. The size and shape of these particles changed with heat input. With increasing heat input, number of fine particles in the copper bead increases. For the same brazing speed, when the wire feed rate was higher, the particles changed from ball shape to star shape and eventually to flower-like shape and the size of the particles increased progressively (Fig.5). Li et al. [20] also reported the similar change in the shape and size of the dendrites in the bead.

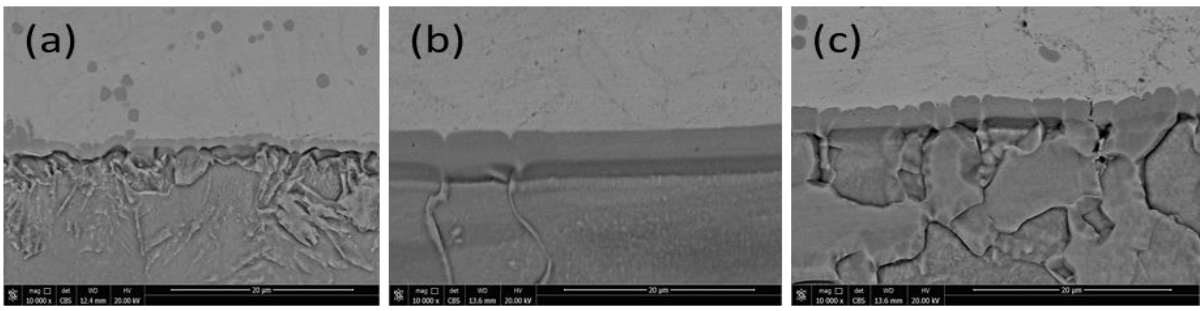

Figure. 4. Microstructure of interface of the joint S4 obtained by SEM (a) root, (b) center & (c) toe

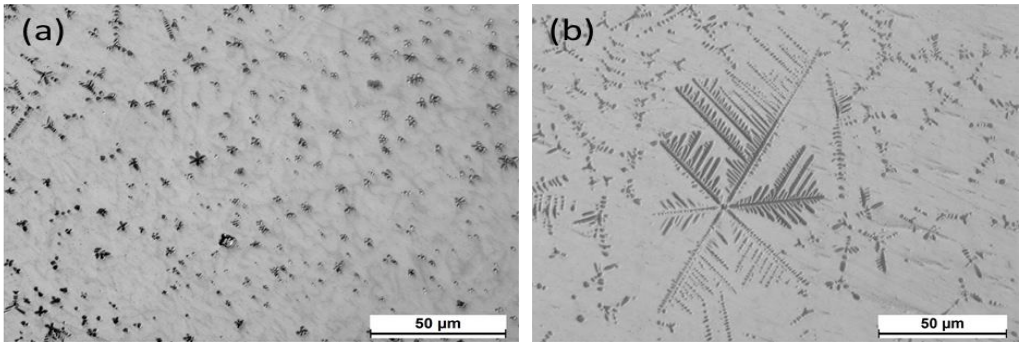

Fig. 5. Microstructure of deposited filler metal obtained by optical microscope (a) S1 (b) S4

Failure load was 3.6 and 4.2 kN for 1.4 and 1.6 mm thick IF steel base metal sheets respectively. From each joint, three tensile samples were machined. All samples fractured from the thinner parent material except sample 6, which fractured along the interface of braze and base material. This was due to the presence of a very thin intermetallic layer (0.4 μm) due to the insufficient heat input at the corresponding MIG brazing parameters. Very small wetting length could also be an appropriate reason for the sample failure from the lower interface. The fracture modes are shown in Fig. 8. Sufficient formation of intermetallic compounds is necessary to achieve an effective bonding between braze and parent material [23]. Insufficient inter-diffusion of atoms across the interface along with low wetting of filler on steel (bonding length= 1.03 mm) caused premature failure at the interface of sample 6 with a failure load of 1.87 kN. Whereas for other joints, the heat input was sufficient for the growth of intermetallic compounds above the critical value. Wetting of molten filler also increased with heat input Fractured surface of sample 6 showed flat striation and minor dimples representing mixed mode failure while fractured surface of parent material exhibited dimples and voids indicating ductile failure.

Micro-hardness profile is shown in the schematic diagram Fig. 9(a). Two samples from each brazing speed (one at lower WFR and the other one at higher WFR) were selected to determine the effect of dendritic fraction on micro-hardness of the deposited filler material. Hardness profile is shown in Fig. 9(b). Hardness of the deposited filler metal increased proportionally with the amount of dispersed Fe-Al intermetallic dendrites and is termed as dispersion hardening [13]. No significant change was observed between the hardness of unaffected parent material and HAZ.

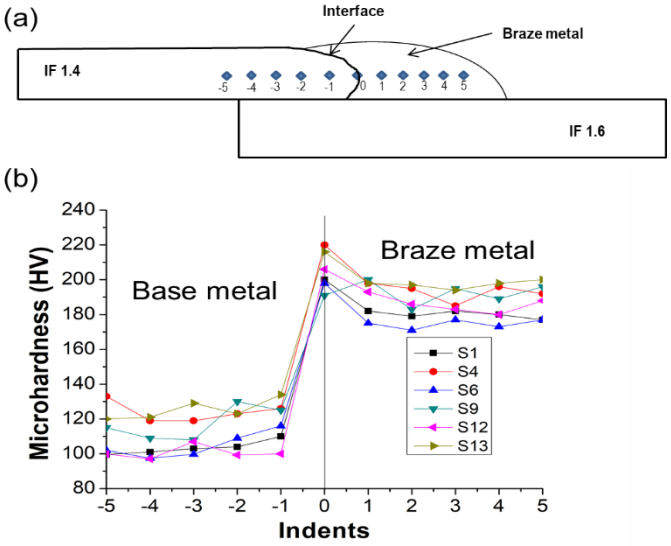

Figure. 9. (a) Schematic of indentation (b) Hardness profile

4. Conclusions

- Intermetallic layer thickness at the interface is proportional to the heat input. Thickness of the layer is higher at the centre of the bead compared to the edges due to more heat experienced by the base metal at the centre which facilitated higher inter-diffusion of Fe & Al atoms across the interface in comparison to the corners.
- Fe-Al dendrites were formed in the bead due to melting of upper steel sheet. The distribution and size of these dendrites changed from ball shaped (small) to larger ones (flower like shaped) with increasing heat input.
- Dispersion of the Fe-Al dendrites in the deposited bead led to the hardening of soft Cu matrix. Micro-hardness of the deposited filler metal increased with increasing dendrite fraction.
- A critical intermetallic layer thickness (1μm) is essential to achieve sound joint with failure in the thinner steel sheet of the selected joint configuration. Below 1 μm, the joints failed from the interface at a lower failure load.

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DISTILLERY INDUSTRY WASTEWATER TREATMENT BY UASB REACTOR AT PILOT SCALE

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Abstract
The Effluent from the sugar industries contained high amount of Molasses, which further pollute the environment in many ways. Many researchers have attempt to form and modify various UASB reactor and made improvement in the quality of effluent. This study also focused on improving the efficiency of UASB reactor by modifying the filtering process to achieve the higher efficiency and also economically viable as compare to previously availably models of the mentioned reactor. The parameters to represent the efficiency were considered such as P_H, Chemical Oxygen Demand (COD), Bio-chemical Oxygen Demand (BOD), Turbidity and TSS. The result showed that there is 3%- 4 % overall improvement with modified reactor.
Keywords - UASB DO COD BOD WW

1. Introduction

In the past, industrialised nations experienced significant progress in their efforts to enhance water quality using contemporary sewage technologies. The most common treatments often rely on advanced technology, which does not demand for a significant amount of process energy (Technologien et al, 2001). The sugar industry's peripheral distillery sector relies mostly on the raw materials used in sugar production. The manufacture of various grades of alcohol suited for diverse operations, such as the production of liquor, is the foundation of the distillery industry. This fermentation of the raw material takes place utilising specialised fungal cultures.The distillery, malty, and brewery sectors make up the bulk of the Indian fermentation industry classifications. Molasses is the primary fuel used by the majority of distilleries in India. This is because there are numerous sugar factories nearby that can meet the demand for molasses. The lack of food grains for operations involving grain-based distillation is another factor contributing to the high concentration of molasses-based units. The available grain stock should be sufficient to meet the country's population's needs for food. Still, distilleries have severe concerns about how to dispose of the vast amount of bio-machinated spent wash. Because the used wash could damage a surface, the Central Pollution Control Board (CPCB) has also established very strict guidelines for its correct disposal.The distillery and sugar sectors are somewhat dependent on one another. The urgent need to address the environmental problems of these businesses calls for an integrated approach. To treat various wastewaters, a variety of reactors have been utilised, one of which is

the up flow anaerobic sludge blanket (UASB) (Arshad et al, 2009). This reactor's treatment process was in motion. Very first, under anaerobic conditions, bacteria break down organic pollutants in wastewater, producing methane and carbon dioxide. The degrading process is more effective than more conventional aerobic producers and only yields 5–10% sludge.This significantly lowers the price of sludge disposal. The up flow anaerobic sludge blanket is the most used anaerobic method (UASB). In the UASB process, the waste that needs to be treated is put at the bottom of the reactor. Moving higher, the waste water flows over a sludge blanket comprised of biologically produced granules or particles. The waste is processed when it comes into touch with the granules. The UASB is most frequently used in the beverage, brewery, culinary, and tannery industries (karthikeyen et al, 2011).

Due to disposal of distillery industry effluent in open area without proper treatment this causes bad impact on environments like degrades agricultural land, poor water quality in nearby areas. Various reactor were used for the treatment of distillery wastewater including UASB, SBR etc in current study we are focusing on UASB reactor by adding PVC rings in it this may increases the efficiency of the reactor.

The current pilot study was based on Up flow Anaerobic Sludge Blanket Reactor (UASB), modified with PVC rings, so that the efficiency for the removal of organic material available in water based on the parameters COD, BOD, TSS and Turbidity and compare the same with the previously available UASB reactor.

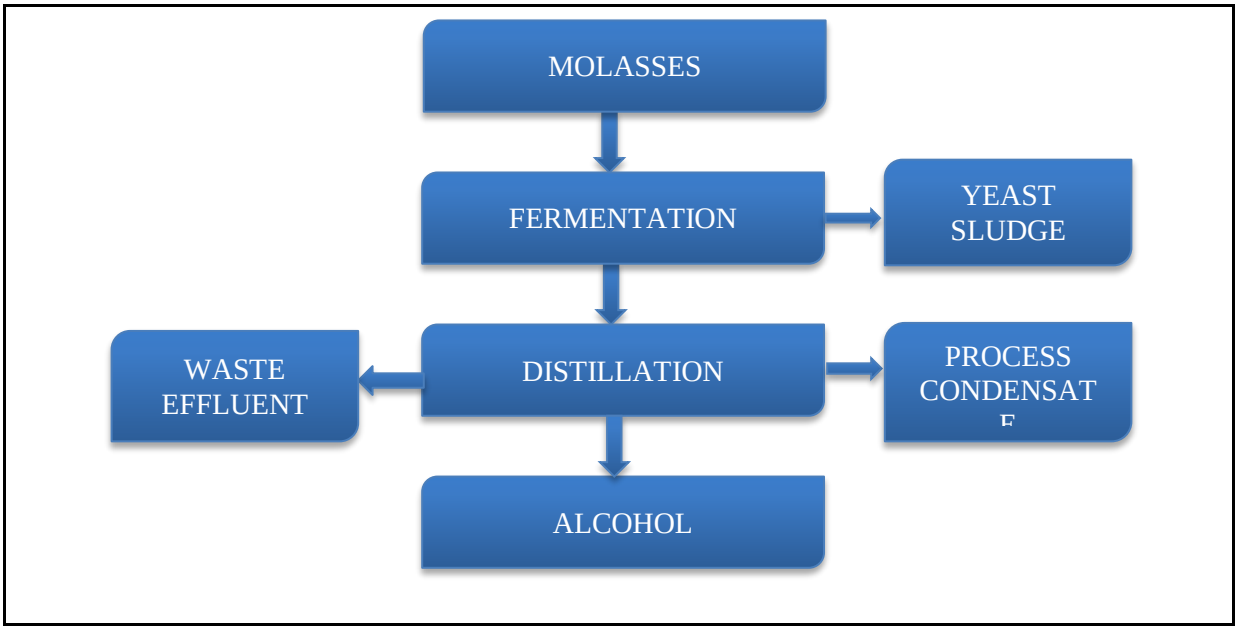

Figure-1: Flow chart of Distillation Process

2. Collection of sample

For the upflow anaerobic hybrid reactor, we can use that type of wastewater sample which has high COD values which gives the satisfactory results. So, the selection of distillery industry waste water is done which has high COD concentration and other parameters are also high. The sample was collected from Simbhaoli, Hapur Uttar Pradesh 245207. The sample was taken from inlet tank after the fat separator. Fat separator for distillery industry waste water is necessary before treatment. Distillery industry waste water contains highly suspended solids which are larger in size and they may cause treatment problems. Because of hindrance materials which are present in distillery industry waste water, chocking problem in pipes will occur.

Activated sludge which is used in bottom of reactor that are highly rich in activated micro-organism that are useful for treatment purposes in reactor, is collected from full scale UASB reactor, SimbhaoliHapur, Uttar Pradesh. This UASB reactor is in use for the treatment of distillery industry waste water that releases from the distillery industry waste water.

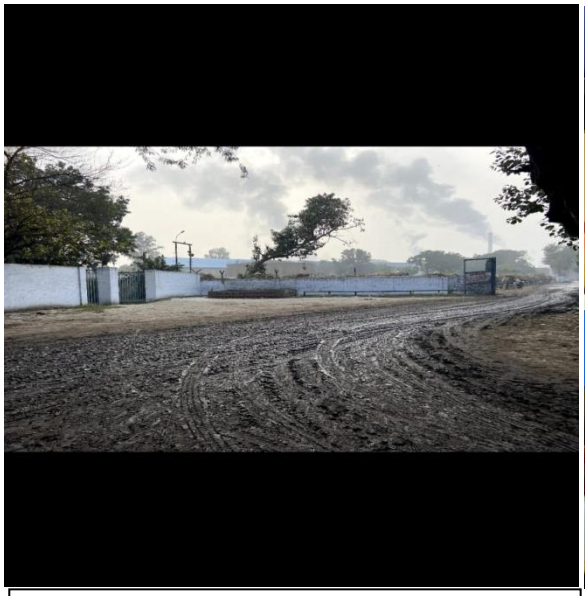

Figure-2: Actual Site Photograph

Figure-3: UASB Reactor

2.1 Characteristics of sample

The Distillery industry waste water sample has different characteristics which causes the serious problems in environment. For the better result of reactor, all the different characteristics of slaughter have to be find out by which we can check the efficiency of reactor.

Table-1: All different parameters which are finding out in laboratory are as follows:

Parameter	Value
COD (mg/l)	71000.869
BOD (mg/l)	42879.43
TSS	9000
Turbidity (NTU)	230
Ph	3.8

2.2 Upflow anaerobic sludge blanket reactor

Anaerobic hybrid reactor is a reactor in which treatment occurs with a process of suspended growth as well as attached growth system. It is an anaerobic reactor in which treatment is occurred in the absence of air or oxygen. The upflow anaerobic hybrid reactor is used for the treatment of various types of waste water which has high organic matter.

The Hybrid word is used for this reactor, because it is the combination of both anerobic sludge bed and upflow anaerobic filter for solid retention, biomass attachment which helps in growth of methanogenic bacteria. The lower portion of reactor is filled with activated sludge where flocculants and granular sludge are developed and the upper part is used as filter in which poly vinly chloride (PVC) as a filter media is filled for the proper treatment of waste water. The upflow anaerobic reactor is designed in such a way that, the flow of waste water is upside means, flow is enter from bottom of reactor and outlet is collected from upper side. This reactor is very useful for the treatment of waste water and for the biogas production because of methanogenic bacteria. So, the maintenance of methanogenic bacteria is very important for the performance of reactor. It is seems that, these bacteria are highly sensitive for temperature; at the increase in temperature, methanogenic activity is also increase and vice versa. This reactor requires a less area as compare to other treatment process as it is very effective and gives better results. This reactor requires low cost for setup and for operational purposes because it has no need of additional chemicals or electricity for running.

The UASB was designed to treat the waste water anaerobically for biogas generation. The temperature range (which affects solid retention time), and the flow fluctuations (which affect the up flow velocity) are also considered and modification in current study was also done by imposing 10 PVC rings, which may increase the filtration efficiency of the reactor.

Table-2: Parameters of UASB reactor used in current study shown in Figure 5

Parameter	Value
Volume (L)	4.6
Flow rate (l/d)	2.16
Mass loading rate (g COD/l h)	0.14
Hydraulic loading rate	0.47
Temperature (C	20-30

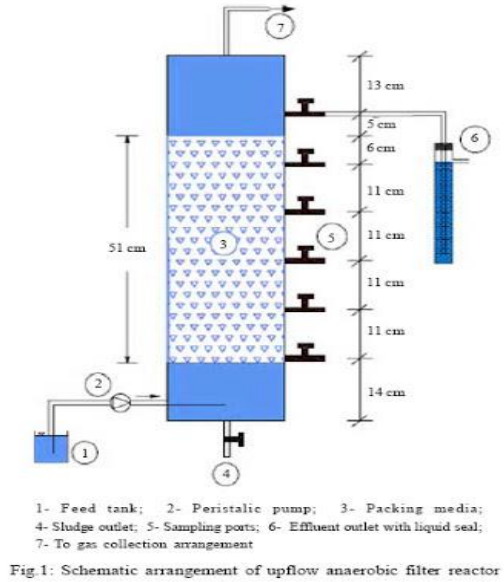

Figure-4: Schematic diagram of reactor

Figure-5:Actual view of Pilot

2.3 Different parameters are as follows:

Determination of PH - The PH is find out by PH meter as shown in Fig.6. The PH meter gives the result in between 0 – 14. From 0 to 7 it shows acidic nature of sample and between 7 to 14 it shows base nature of sample and at 7 it is neutral. It is determine in daily period of time for measuring the acidic or basic nature of sample.

Figure-6: pH meter

Chemical Oxygen Demand (COD) is an indirect measure of the total organic matter widely used for wastewater monitoring, design and operation of STPs. The instruments used to measure COD is shown in Fig. 7 to 9.

Figure-7:COD digester

Figure-8: Prepared sample of COD

Figure-9: Spectrophotometer

BOD is the amount of oxygen consumed in one litre of water by microorganisms while they oxidise the entire organic matter present in a specified temperature and measured using different flasks' samples as shown in Fig.10 & 11.

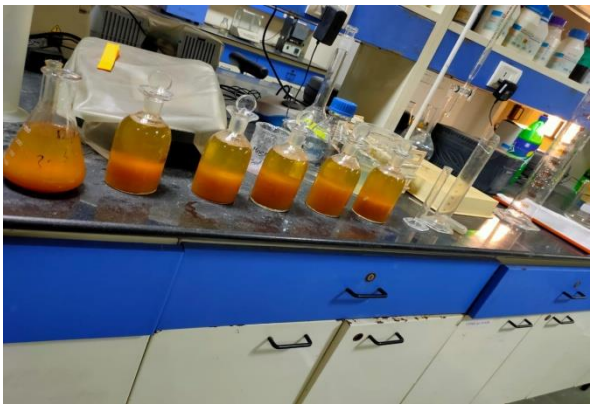

Figure-10:Prepared sample in

Figure-11:Sample after adding conc.H2So4

3. Result

The characteristics of Distillery industry waste water and activated sludge is determined in laboratory. The treatment of Distillery industry wastewater by Up flow anaerobic sludge blanket reactor is performed at laboratory level.

Ph of the sample was observed 7.4 after the treatment in up flow anaerobic sludge blanket reactor.Figure 12 graph contains information for 10 days (Day 1 – Day 10) when reactor starts and it can be seen that removal efficiency of reactor in term of COD at day 1 was 7.482% and at day 10 it was 13.793%.

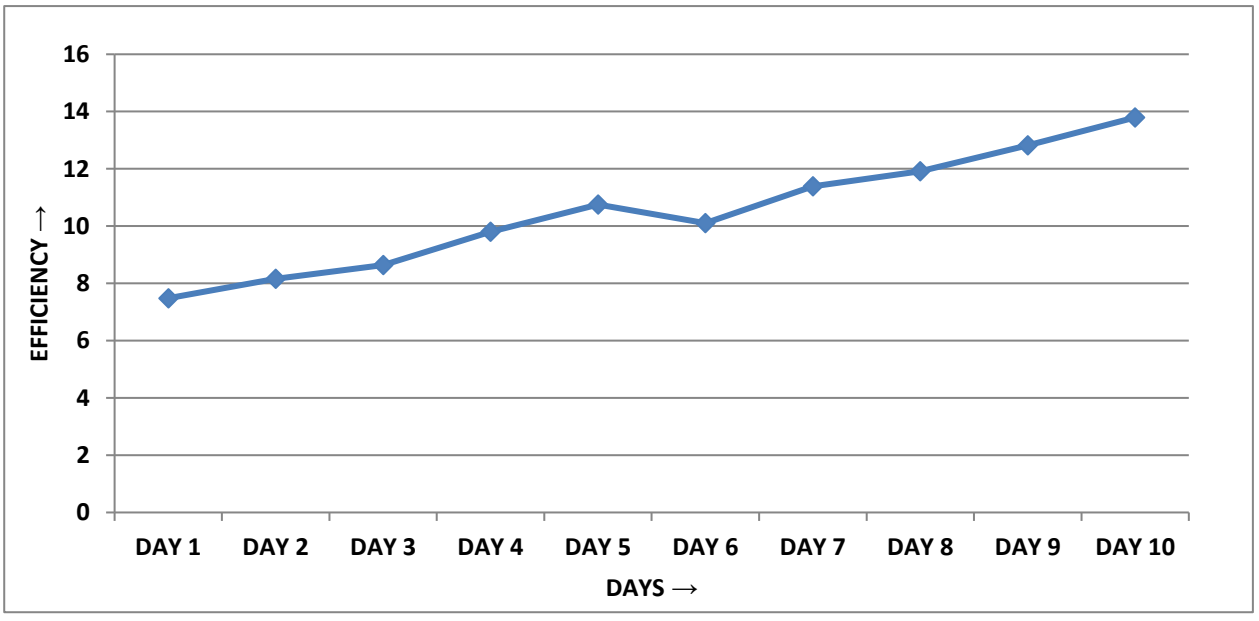

Figure-12:Graph of % COD removal efficiency v/s days for 1/10 diluted sample

Different graphs were obtained of % COD removal efficiency v/s days for different diluted samples. From the table 3, the information for 40 days (Day 11 – Day 50) when reactor starts and it can be seen that removal efficiency of reactor in term of COD at day 11 was 32.706% and at day 50 it was 69.207%.

Table-3: removal efficiency by using modified UASB reactor for 40 days.

S.NO	DAYS	COD INLET(mg/l)	COD OUTLET (mg/l)	EFFICIENCY (%)	Ph at outlet
1.	Day 11	22700.7	18500.4	18.5	4.82
2	Day 15	21300.2	16000.5	24.88	6.53
3	Day 20	18500.1	11500.1	37.378	7.62
4	Day 25	18400.8	11300.8	38.586	5.93
5	Day 30	16900.8	9800.3	42.011	6.32
6	Day 35	14800.2	7900.4	46.621	7.22
7	Day 40	14700.1	7700.8	47.619	6.65
8	Day 45	14000.2	7100.1	49.28	7.41
9	Day 50	11900.4	5500.8	53.781	6.66

From the Figure 17 it can be observed that the efficiency of reactor at day 50 decreased by 2 percent due to inappropriate environmental conditions and then reactor .

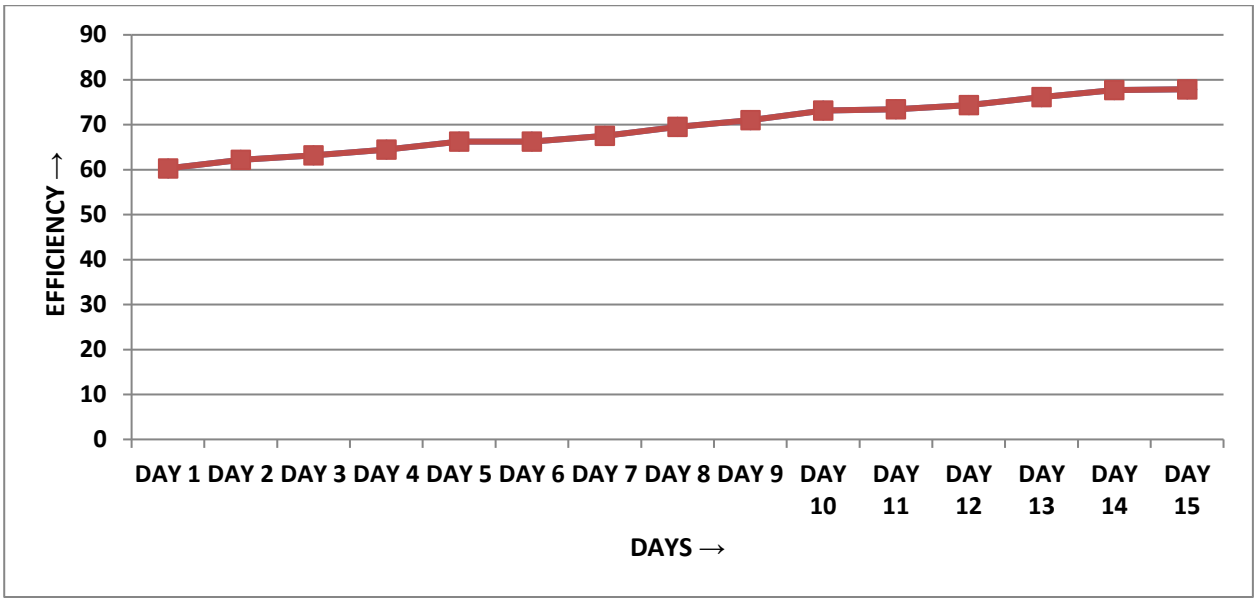

Figure-17: Graph of % COD removal efficiency v/s days for undiluted sampleandit can be seen that removal efficiency in term of COD varies from 7.482% to 77.895%.

Bio-chemical oxygen demand

BOD at inlet and outlet of reactor and its % removal efficiency

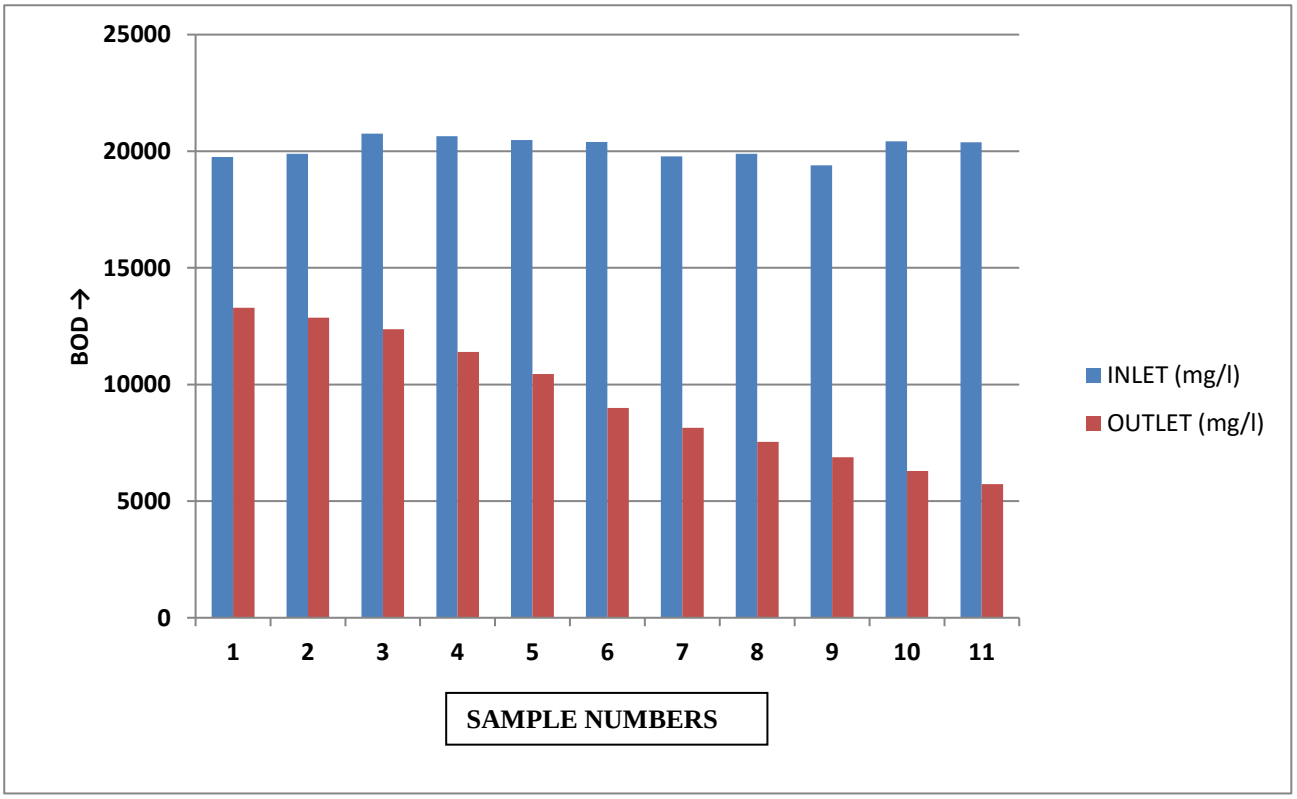

Figure-18:Graphical representation of BOD at INLET and OUTLET

It can be seen that removal efficiency of reactor in term of BOD varies from 32.706 to 71.878%.

Total suspended solids (TSS) are defined as solids in water that can be trapped by a filter. To measure TSS, the water sample is filtered through a pre-weighed filter. The residue retained on the filter is dried in an oven at 103–105°C until the weight of the filter no longer changes.

TSS at inlet and outlet and its % removal efficiencies.

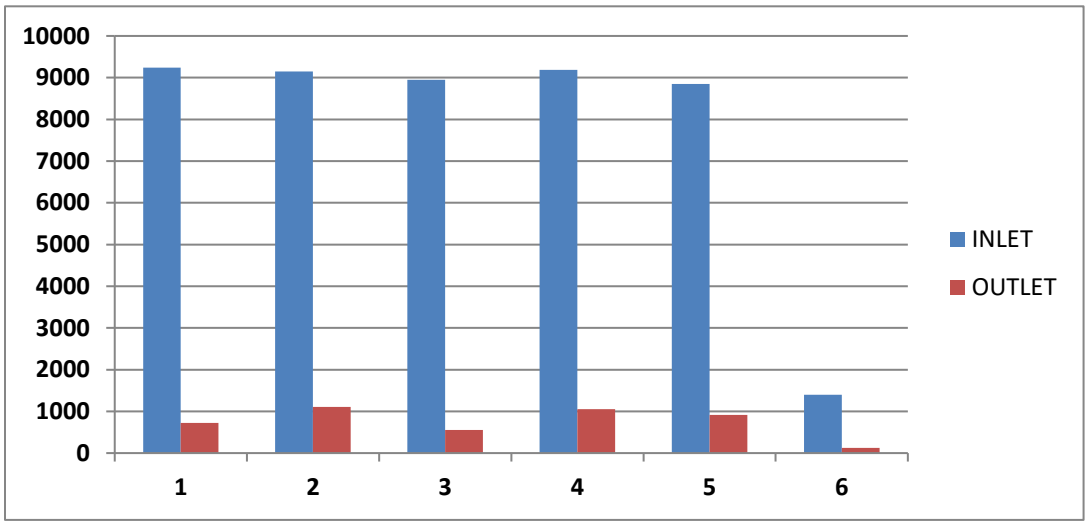

Figure-19:TSS at INLET and OUTLET

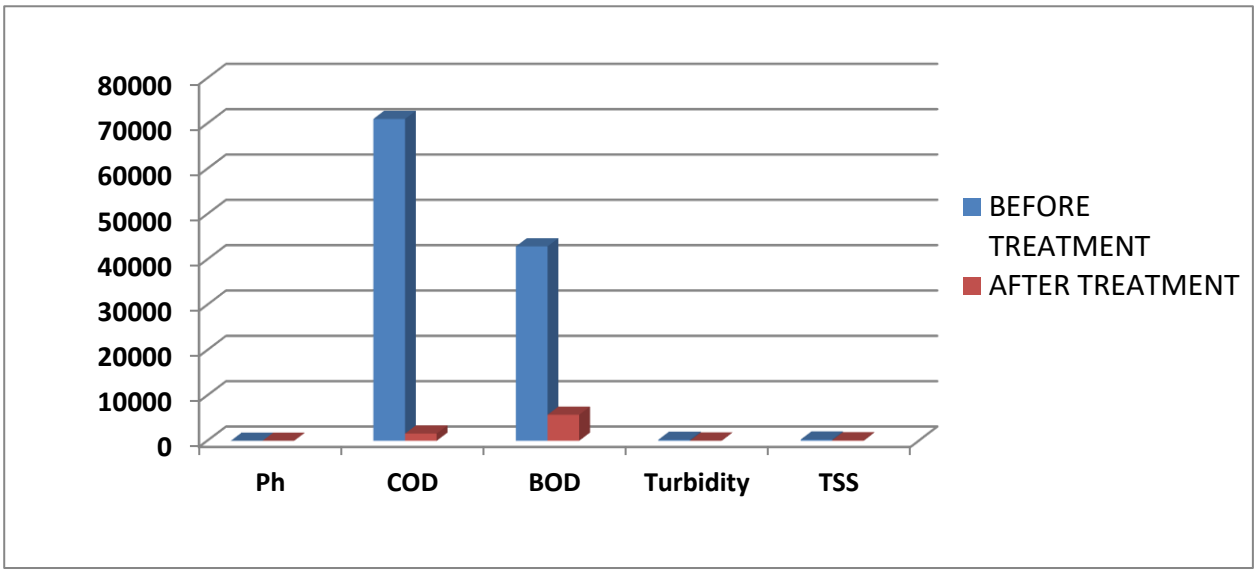

Figure-20:Graphical representation of before and after treatment concentrations of various parameters

Table-4: Values before and after the treatment if waste.

	COD (mg/l)	BOD (mg/l)	TSS (mg/l)	Turbidity (NTU)	Ph
BEFORE	71000.869	42879.43	9000	230	3.8
AFTER	1590	5734.1	122.4	47	7.4

Table-5: Tabular representation of efficiency of reactor in percentage to treat distillery waste.

Efficiency = ((Inlet –Outlet) / (Inlet)) * 100

S.No	Parameters	Concentration	Removal Efficiency (%)
1	Ph	7.4	52.70
2	COD	1590 mg/l	77.895
3	BOD	5734.1 mg/l	71.878
4	Turbidity	47	79.56
5	TSS	122.4 mg/l	56.3

4. Conclusion

The up flow anaerobic reactor is used for the treatment of DWW at different dilution (1/10, 1/8 1/6, 1/4, ½ and undiluted sample at pilot scale.

- pH of the sample was 3.8 and after treatment results showed that I was 7.4.
- COD was calculated at different dilutions and results showed that initially the efficiency of reactor was 7.482% and after the continous treatment of waste for 90 days reactor efficiency increased upto 77.895%.
- BOD for samples were calculated at the interval of 5 days initially DO was checked at day 1 and day 5 and it was observed that initially the efficiency of reactor was 32.706% and after 90 days increased to 71.878%.

- Total suspended solids was 9000 mg/l before the treatment and it was 122 mg/l after the treatment

At day 1 turbidity of the distillery waste sample was 230 NTU and after treatment it was 47 NTU. Detention time for the reactor was 24 hours and the flow inlet, 135.72 ml/hr were same throughout the period of treatment. On the basis of above factors it may state that the modified reactor increased the efficiency of treating the effluent which contains organic matter.

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STUDIES ON ANTIFUNGAL EFFECT OF SILVER NANOPARTICLES

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Abstract

The current study focuses on the environmentally friendly manufacturing of silver nanoparticles using Azadirachta indica and Tinospora cordifolia plant extracts. Aqueous silver ions were seen to have a dark brown hue after being exposed to plant leaf extract, demonstrating the formation of silver nanoparticles. A peak between the wavelengths of 390 nm and 540 nm, which are characteristic peaks of silver nanoparticles, was discovered by UV-Vis spectroscopy analysis. Other methods, like Field Emission Scanning Electron Microscopy (FESEM), were used to analyse the synthesised silver nanoparticles, which revealed uniformly formed spherical nanoparticles. The elemental composition was confirmed by an absorption peak that appeared in the Energy Dispersive X-Ray (EDX) data at about 3 keV. Silver nanoparticle chemical interactions were seen using Fourier Transform Infrared (FTIR) technology. Further, the study focused on comparison of antifungal effect of chemical fungicides (Mancozeb 75%, Carbendazim 12%, Mancozeb 63%) and silver nanoparticles against *Fusarium pallidoroseum* under *in vitro* conditions. The study found that silver nanoparticles had potent antifungal action against isolated fungus, which will usher in a new era of less dangerous fungicides that will eventually replace the hazardous and currently used cytotoxic fungicides.

Keywords: *Silver nanoparticles, Azadirachta indica, Tinospora cordifolia, Fusarium pallidoroseum, chemical fungicides.*

1. Introduction

Metal nanoparticles are produced and studied as a result of nanotechnology. These nanoparticles demonstrate one of the few antibacterial actions, and this characteristic is a crucial weapon in the fight against microorganism resistance to conventional medications (Shenashen et al., 2014).

Microbial disease is a significant issue in farming and medical care area around the world. Consequently, nanoparticles are basic to create novel antimicrobial specialists with flexible qualities, for example, antimicrobial power, low poisonousness and extraordinary similarity. Due to their electrostatic attraction to oppositely charged microbial cells and large surface-to-volume ratio, nanoparticles have attracted widespread attention in this particular situation, leading to improved physicochemical properties and enhanced antimicrobial activities of the NPs (Jain et al., 2018;Lakshmeesha et al., 2014; Kavyashree et al., 2015). Recently, there has been a lot of publicity

about the antimicrobial capabilities of nanoparticles, especially their antibacterial and antifungal actions (Wani et al., 2019; Khan et al., 2018; Salem et al., 2015; Elgorban et al., 2016).

Silver nanoparticles are the main nanoparticles with worldwide logical consideration because of their one of a kind properties, including powerful antimicrobial exercises, substance security, and high warm and electrical conductivity (Muñoz-Bonilla *et al.*,2019; Tripathi,*et al.*,2018;Tran *et al.*, 2013; Kumar *et al.,* 2013;Yang *et al.,* 2015; Quester *et al.,* 2016). In any case, combination of AgNPs produces harmful effects, for example, ammonia (Shenashen *et al.,* 2014), which can influence human wellbeing and the environment (Panáček *et al.,* 2009). AgNPs have been produced using a variety of methods, including plants, microbes, and non-toxic materials (Iravani et al., Quester et al., 2013; Sintubin et al.,2012).

These characteristics enable the development of AgNP as an antimicrobial specialist in a variety of products, including cleansers, plastics, food, and materials, increasing their fair value (Singh et al., 2018, Franci et al., 2015). In any case, the in vivo utilizations of AgNPs in harvest assurance have once in a while been inspected (Mishra *et al.,* 2017).However, micro molar groupings of silver have no destructive impacts on people (Berger *et al.,* 1974). One of potential applications is its utilization in plant infection the executives. Up to now, restricted exploration proof on the utilization of AgNPs for the control of parasitic microbes, has been distributed (Jo *et al.,* 2008).

2. Material and methods

2.1 Plant materials

Tinospora cordifolia and Azadirachta indica were employed as plant resources to create silver nanoparticles (Fig.1).

Figure.1 shows the use of Tinospora cordifolia and Azadirachta indica, for the synthesis of silver nanoparticles.

2.2 Fungal isolate

The soil sample was used for the isolation of *fugal sp*. The technique, serial dilution was used for serial dilution of soil sample (Kumar *et al.*, 2015). Under aseptic conditions, the suspension was streaked over PDA (Potato Dextrose Agar) media. The plates were then kept at 30°C for a week of incubation. After colony development on petriplates, suspected fungal colonies were sub-cultured on brand-new PDA media. An inoculating needle was first flamed over a Bunsen burner burning inside a Laminar Air Flow (LAF) chamber in order to detect the fungus at the fundamental level. Then, using the needle and a drop of lacto phenol in cotton blue on the slide, a portion of the growth from the culture plate was transferred there. An inoculating loop was used to gently tease the specimen in order to avoid squashing and crowding the mycelia. The materials were examined using an inverted phase contrast microscope to determine their identities. The fungal culture that was believed to be Fusarium sp. was sent to the Indian Agricultural Research Institute - Indian Type Culture Collection (IARI - ITCC) for species level characterization. The fungus will be purified from a soil sample, collected, and subcultured on Potato-Detrose-Agar (PDA) Media.

2.3 Silver nanoparticles prepration and synthesis

The AgNO3 solution (2mM) was made by combining 0.034 g of AgNO3 powder with 1000 ml of distilled water. 48 hours of room temperature drying and fine grinding of about 25 g of fresh leaves produced the powder. 200 cc of distilled water was used to boil the crushed leaves for 30 minutes before they were filtered using Whatman No. 1 filter paper (25 m). This procedure for making plant extracts was modified from Parashar et al., 2009. In order to create AgNPs, an aqueous solution of silver nitrate (2 mM) was combined with leaf extract in a 9:1 ratio, and the mixture was heated to 280°C in an incubator shaker at 150 rpm (figure 3.2). Following time intervals, the biotransformation was routinely observed visually and spectrophotometrically (The method of suggested by Kalaiarasi, et al. 2013).

2.4 Chatateriza‌tion of silver nanoparticles

The bio-change was periodically measured externally using a UV spectrophotometer after time intervals of 0 hours, 4 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, and 120 hours. Further characterisation was carried out using FTIR, FESEM, and EDX, all with the assistance of the Indian Institute of Technology, Kanpur (facilitated from Indian Institute of Technology, Bombay).

2.5 Inhibition of colony formation by different type of silver nanoparticles and compared with chemical fungicides (CFs).

The antifungal effect of silver nanoparticles was evaluated against *F. pallidoroseum* and it was

compared with chemical fungicides (CFs).The CFs which are readily available and used by farmers of western UP that are Abic (Mancozeb 75%), Saaf (Carbendazim 12%, Mancozeb 63%) and Swadheen (Tebuconazole 10%, Sulphur 65%) were purchased from the local market of Meerut, U.P.Potato dextrose agar media was used to culture the test fungal species. The culture media were poured with 2 ml of silver nanoparticles (in SNP1 and SNP2 test plates) and 2 ml of chemical fungicides in recommended concentration (in CF1, CF2, CF3 test plates). The control (C) plate contained only media. Each Petri plate was centrally injected with F. pallidoroseum using an inoculating loop after the media had solidified. At 300C, petri plates were incubated for 72 hours. According to Elamawi et al(2018) .'s recommendation, the antifungal activity of silver nanoparticles was investigated using the colony formation approach in vitro on a Petri dish. After 72 hours, the colony diameters were measured, and the % inhibition was determined.

3. Result and discussion

3.1 Result of isolate *fungal sp.*

Pure cultures of the Fusarium sp were maintained on PDA media after being isolated using the soil dilution procedure (fig.2A). Colonies typically have a cottony aerial mycelium and are either pale or brightly coloured. The fungus showed up as cottony mycelia that ranged in colour from white through colours of yellow, pink, red, and purple. Both macro- and microconidia are typically produced by fusarium species. Hyaline-celled macroconidia typically have an extended apical cell and pedicellate basal cell and range in shape from fusiform to sickle-shaped. The main level of microscopic examination allowed for the identification of the fungus, which had spores with the distinctive canoe form of Fusarium sp (fig.2.B). By using information from IARI-morphological ITCC's characterisation, the species was determined to be F. pallidoroseum.

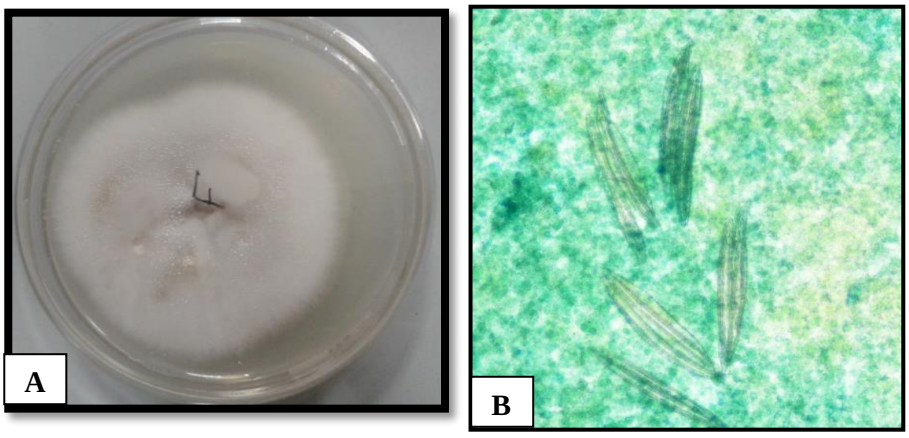

Figure. 2: Pure Culture F pallidoroseum on PDA media (A) and Microscopic image of F - pallidoroseum having canoe-shaped spores (B).

3.2 Plants extract, Synthesis and characterization of Silver Nano-particles

After the addition of 2 mM AgNO3, the plants gradually expanded into the shade, demonstrating an improvement in AgNPs. Because of how the AgNPs were arranged, the reaction mixtures' colour changed to a dark, earthy hue. The association of silver nanoparticles from Tinospora cordifolia and Azadirachta indica is depicted in Fig. 3.B&C. Previous studies also support this study, the use of *Azadirachta indica* and *Tinospora cordifolia* leaf extract for the synthesis of silver nanoparticles (Thakur *et al.*,2019; Rajendaran *et al.*,2019; Roy *et al.*,2017; Ahmed, *et al.*,2016; Nazeruddin *et al.*, 2014; Selvam *et al.*,2017; Begum *et al.*,2019).

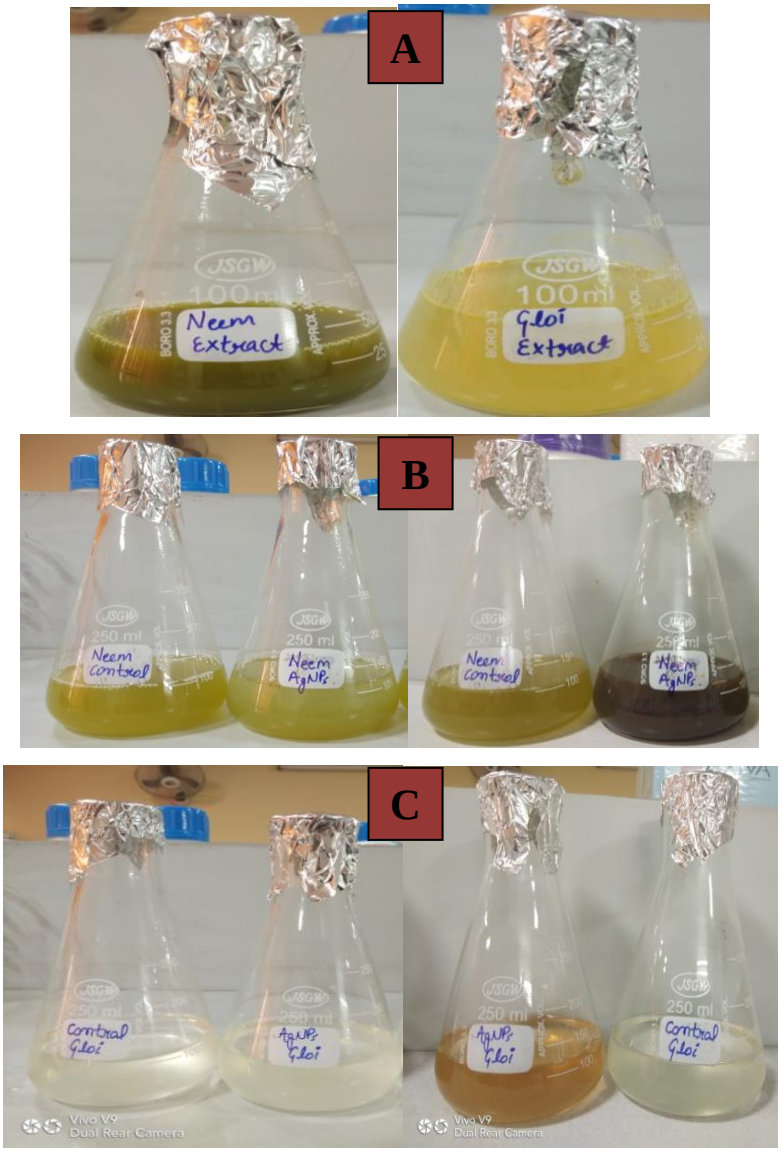

Figure.3 A shows the plants extracts of Azadirachta indica and Tinospora cordifolia, B & C shows the control and test flask of Azadirachta indica and Tinospora cordifolia respectively.

3.3 Characterization of silver nanoparticles

3.3.1 UV–Vis spectral characterization

The chromatic change of the reaction substrate might be used to determine the UV-vis characterisation of silver nanoparticles since the colour shift from green to brown indicates the biotransformation of the Ag+ ion to Ag0 (Singhal et al.,2009; Lengke et al.,2006; Jena et al.,2013). Previous findings for the biosynthesis of AgNPs from plant extracts provide substantial support for the results of the current study (Nayak et al.,2011 and Kaler et al.,2013) The generation of AgNPs from Tinospora cordifolia and Azadirachta indica is shown in Figs. 4 and 5. The peaks at 530 and 520 nm can be seen.

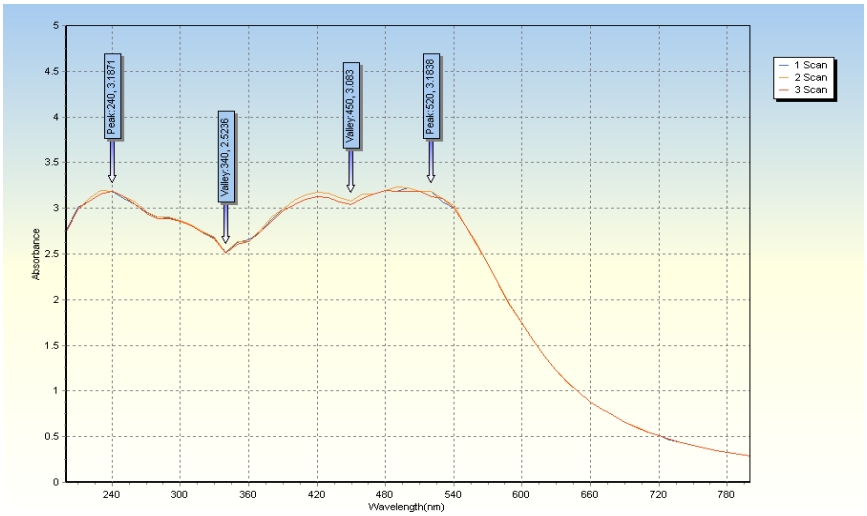

Figure.4 Shows the UV spectra graph of Azadirachta indica.

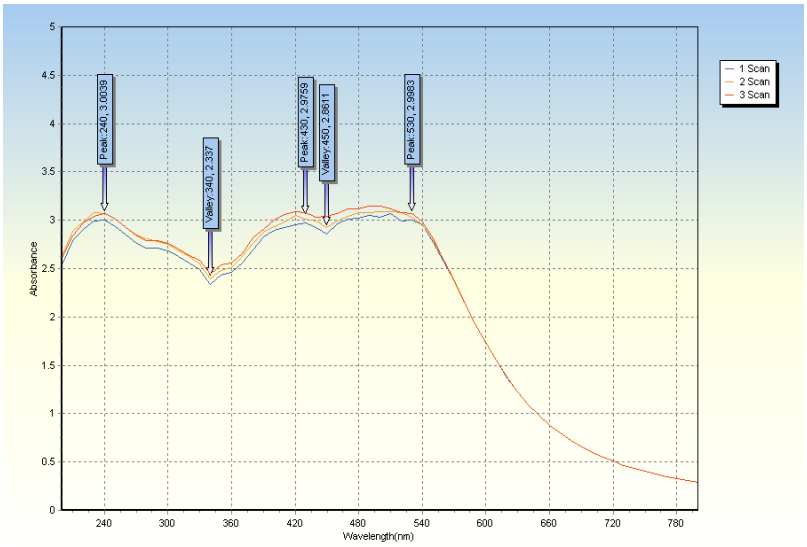

Figure.5 Shows the UV spectra graph of Tinospora cordifolia.

3.3.2 FESEM analysis of AgNPs

The FESEM analysis of AgNPs were done from Kanpur's Advance Imaging Center, Indian Institute of Technology (IIT). The photos were taken using the Everhart-Thornley Detector (ETD) in the high-strain, 15 kV electron mode (EHT). Silver nanoparticles showed typically spherical, under 100 nm-sized particles. The particles were polydispersed, spherical, non-smooth, and watchful. Additionally, analyses of the SEM image revealed nanoparticles with a few micrometers in size. The nanoparticles were made from Tinospora cordifolia and Azadirachta indica and ranged in size from 20 to 75 nm (Fig.6 & 7).

This discovery is supported by earlier studies as well. The nanoparticles were round and oval in shape. Few individual nanoparticles were also determined because most of the nanoparticles were aggregates (Suman et al., 2013). The picture confirms the findings of the SEM and FESEM (Guzmán et al., 2009) with clusters of tiny grains and a few scattered nanoparticles. Silver nanoparticles from the leaf extract of Malachra capitata were analysed using FESEM and EDX (srirangam et al.,2017).

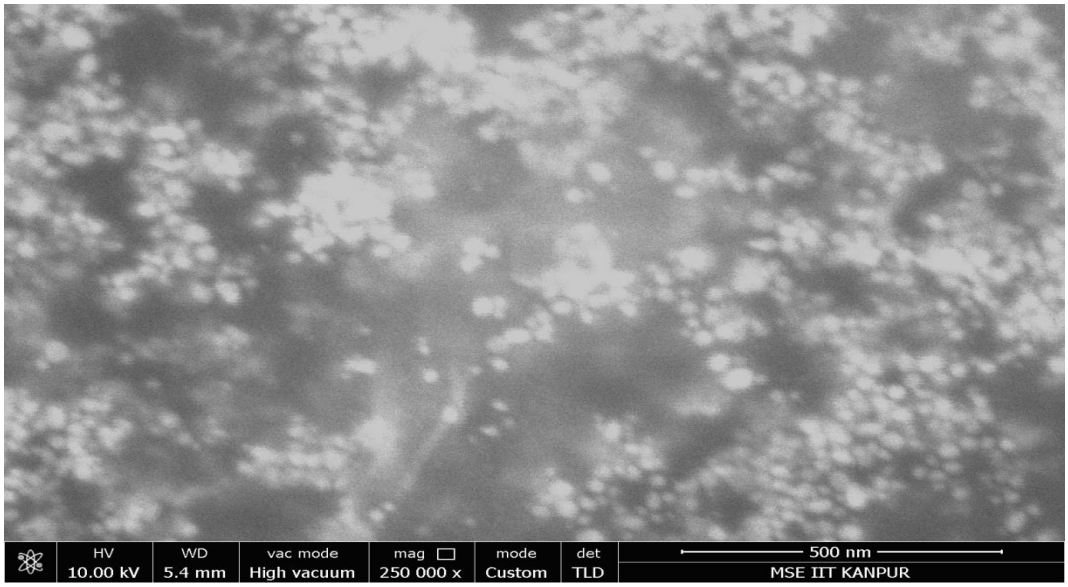

Figure6: Shows the FESEM images of AgNPs synthesized from A. indica.

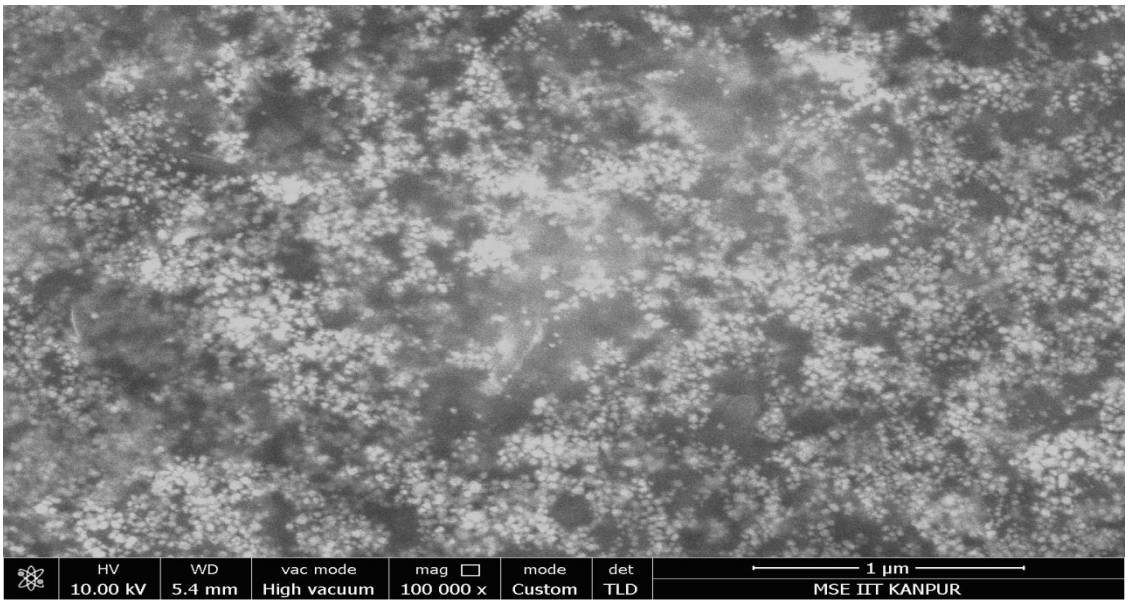

Figure.7: Shows the FESEM images of AgNPs synthesized from Tinospora cordifolia.

3.3.3 EDX analysis of AgNPs

Additionally, this office benefited from Advance Imaging Center, IIT, Kanpur (UP, India). The EDX report displays the AgNPs' EDX scope. A qualitative and quantitative status of the elements that might be involved in the creation of nanoparticles is provided by EDX analysis. Silver (Ag) and aluminium apexes were seen in the EDX range (Al). The optical digestion peaked at 3 keV, according to EDX analysis. The EDX scopes of the AgNPs tests are shown in Figures 8 and 9, where the X-center point denotes the imperativeness in keV and the Y-center denotes the power check. Due to their surface plasmon resonance, metallic silver nanocrystals usually exhibit an optical absorption peak at about 3 keV. (Magudapatty et al., 2001; Ibrahim et al., 2015).

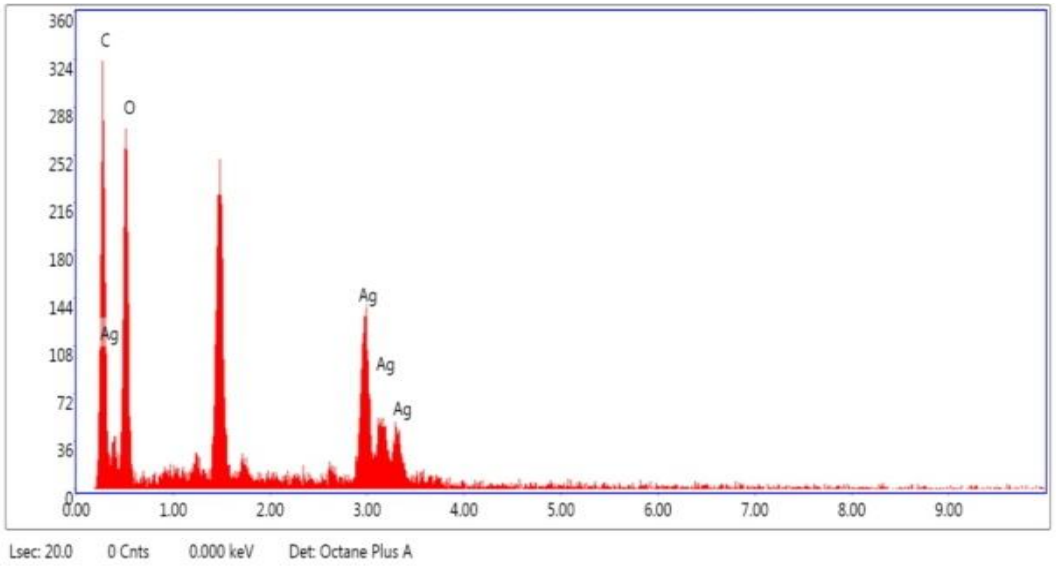

Figure.8: EDX analysis of AgNPs synthesized from A. indica.

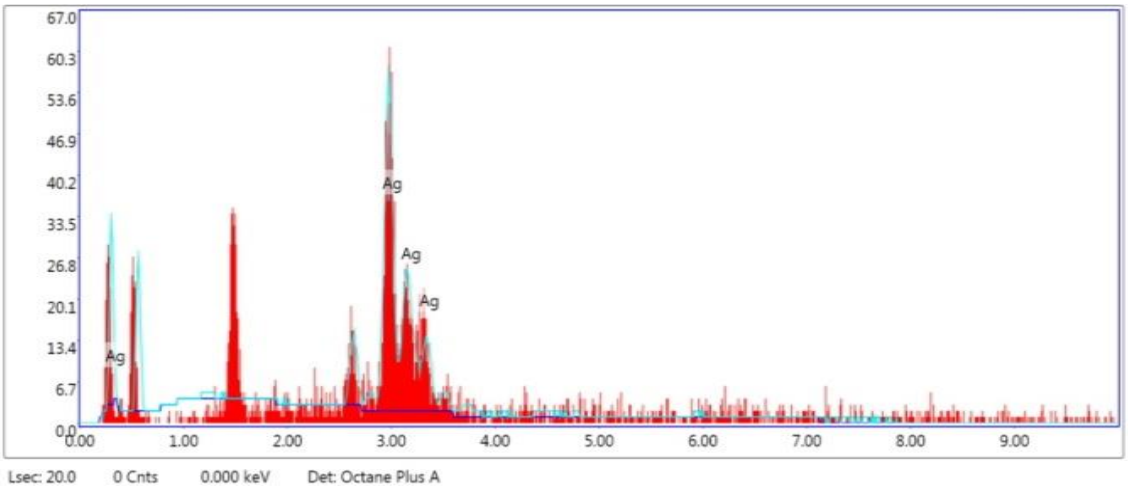

Figure.9: EDX study of AgNPs synthesized from Tinospora cordifolia

3.3.4 FTIR spectra of AgNPs

To determine if there were any potential bio-reducing agents in the extract used, FT-IR spectroscopy investigations were conducted. To identify putative biomolecules involved in the bio reduction of silver and stability of AgNPs, FT-IR studies were carried out (Ananthi et al,2018). The need to find biomolecules for efficient metal nanoparticle stability and reduction has been established. The 13 peaks of *Azadirachta indica* synthesised silver nanoparticles, positions at 3888.13, 3744.40, 3615.73, 3425.12, 2921.66, 1919.62, 1744.06, 1634.41,1542.89,1519.03,1438.22,1420.64,1251.72,1154.67,1110.05,1024.61,846.24,802.29,694.58,600.74,502.98,417.72 cm−1. and the peaks of *Tinospora cordifolia* synthesised silver nanoparticles at 3832.96, 3866.15, 3747.06, 3888.72, 3631.37, 3570.81, 3596.80, 3116.06, 2922.03, 2600.92, 1806.22, 1745.40, 1636.21, 1543.38, 1470.31, 1399.60, 1244.77,1151.91, 1111.59,1022.70,921.44, 833.38, 738.20, 666.64, 619.96, 561.66 cm−1(fig.10&11).

The previous researches strongly support this study, absorbance bands from 3000 to 3600 cm−1 shows the hydroxylamine groups and N-H is O-H group (Pawlak *et al.*, 2003). The O-H hydroxyl functional group in polyphenols and the N-H group, which displays the primary and secondary amines of amino acids, peptides, and proteins, are also peaks at 3427-3436 cm1 (Suart, et al 2004; Cheng et al., 2014). The aliphatic C-H hydrocarbon chains and N-H bending vibration are visible due to the presence of spectral peaks at 2924, 2854, and 1455 cm1 (Cheng et al.,2014). Wave length 1740 cm 1 was used to record the peak of the aldehydic group (C=O), whereas 1648–1621 cm 1 was used to record the peak of amides and other compounds. The bending region of the aliphatic chain was revealed by spectral peaks at 616–672, 522–575, and 44–493 cm1.

Additionally, bands designated at 1381, 1269, 1132, and 1034 cm1 can be attributed to function groups of either sulphur or phosphorus (Castro et al., 2013).

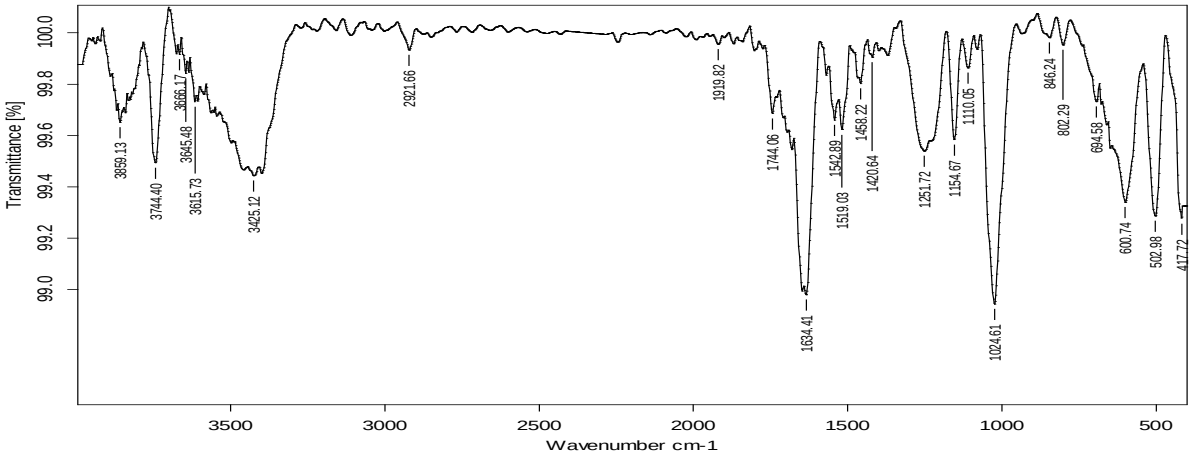

Figure.10: Shows the FTIR spectra of AgNPs synthesized from A. indica.

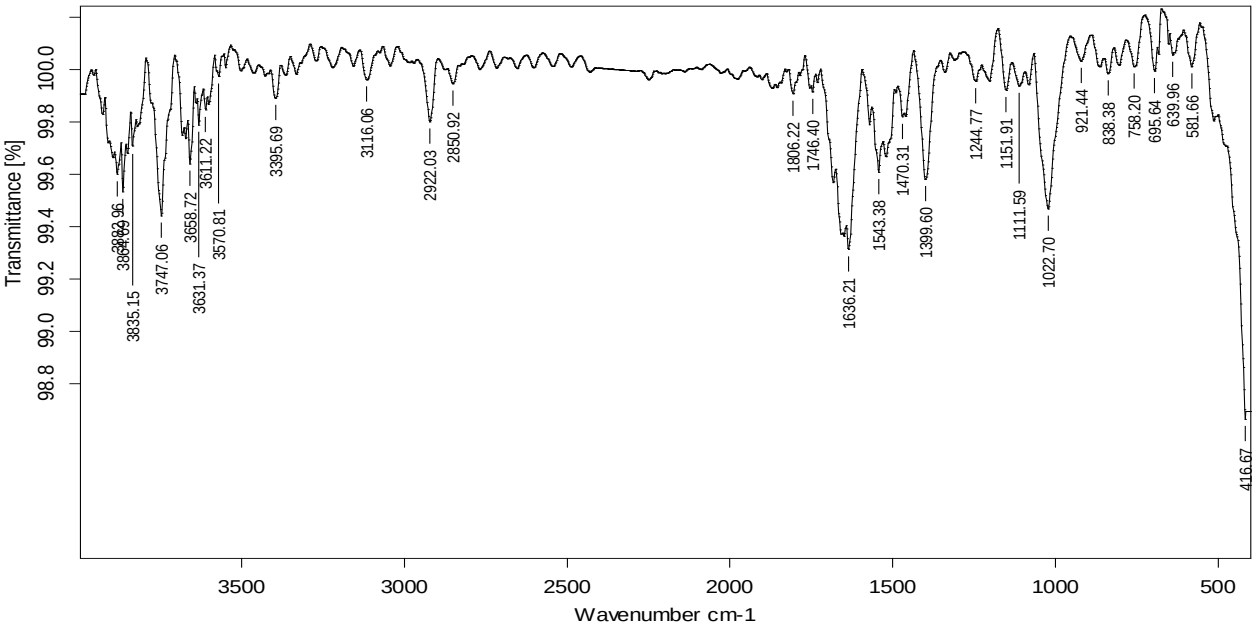

Figure.11: Shows the FTIR spectra of AgNPs synthesized from Tinospora cordifolia.

3.3 Antifungal effect of silver nanoparticles

Using the colony formation method, the inhibitory impact of AgNPs was examined in this work (fig.12&13). For evaluating the zone of inhibition for all treatments at 72 hours, the mean value to three replications was used (figure). According to all of the observed and measured results, the effect of synthetic AgNPs against F. pallidoroseum was found to be relatively similar to that of chemical fungicides.

Similar to this, it is well known that Ag ions and Ag-based compounds have potent antibacterial

effects against a variety of microbes when present in silver nanoparticles (Qais et al., 2019, Soliman et al., 2018, Escárcega-González et al., 2018, Pal et al., 2007). Due to their enormous surface area, which allows for better contact with microbes, silver nanoparticles have effective antibacterial properties (Yun'an Qing et al., 2018). These particles cause the cells to release silver ions, which improve cellular activity (Rai et al, 2009).

In view of the earlier studies (Rónavári et al., 2017; Yun'an Qing et al., 2018; Elamawi et al., 2018), green produced AgNPs can be used efficiently in the control of microorganisms and the prevention of harmful illnesses. AgNPs have been shown to have an inhibitory effect on the plant pathogenic fungus P. grisea (Young et al., 2009; Elamawi et al., 2013). With regard to faba bean, tomato, and barley, biosynthesized AgNPs from T. longibrachiatum increased seed germination % and vigour index and decreased the disease incidence brought on by F. oxysporium, a seed-borne pathogen (Elamawi et al., 2014).

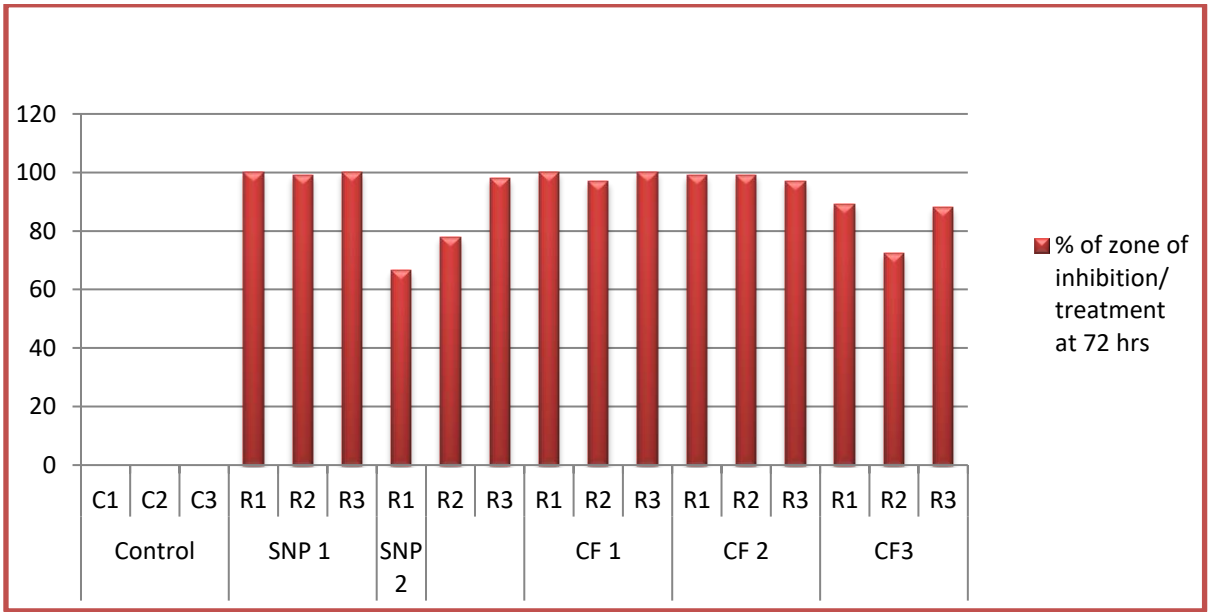

Figure.12: Inhibitory effect of biosynthesized AgNPs for F. pallidoroseum at 72 hrs.

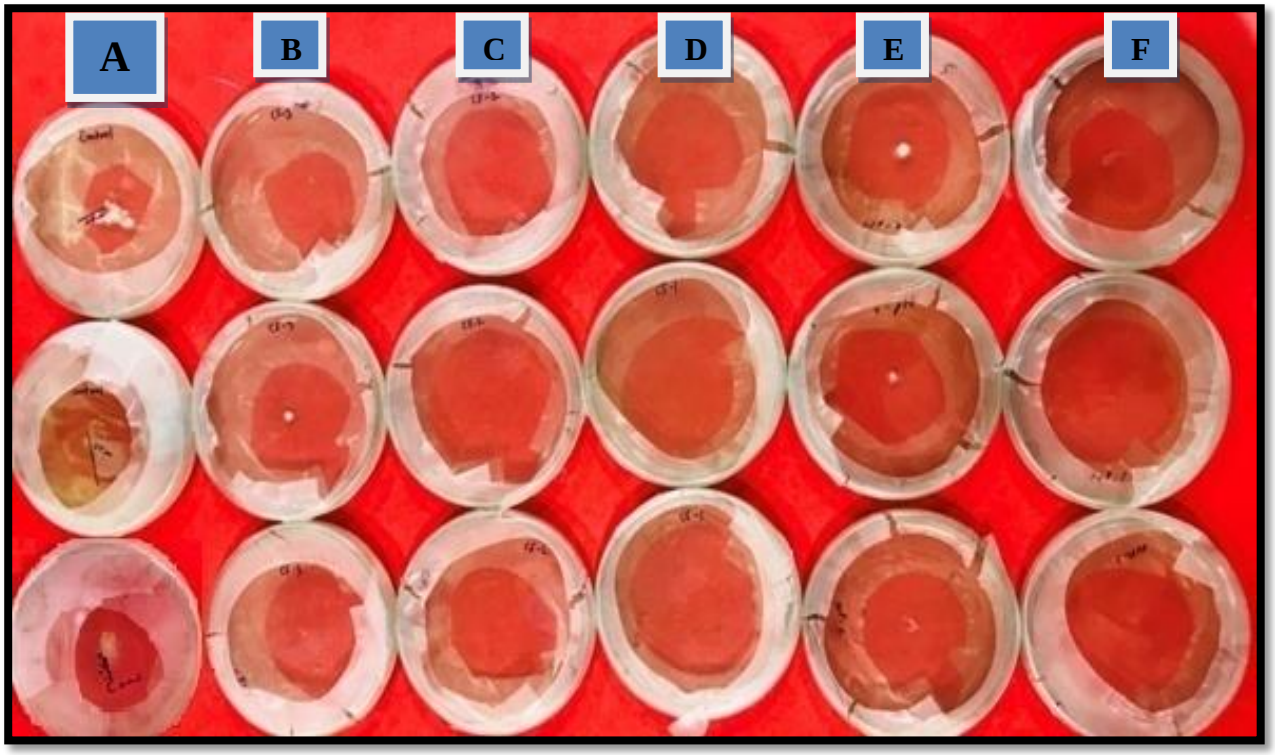

Figure13: Antifungal activity of, (A) control, (B) CF3 (C) CF2 (D) CF1 (E) SNP1 and (F) SNP2 against F. pallidoroseum at 72 hrs.

Conclusion

In this research study, we have concluded that the synthesized silver nanoparticles by using leaves extract proved to be excellent against fusarium wilt. In compression, the silver nanoparticles which is synthesized from Azadirachta indica and Tinospora cordifolia showed quite higher antifungal activity than the chemical fungicides against F. pallidoroseum under in vitro conditions.

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FABRICATION OF ELECTRIC BICYCLE

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Abstract

The bicycle has evolved from being an outmoded humorous invention to a less polluting mode of transportation and a small, incredibly light device for personal movement. Electrical bicycles will be employed in huge cities all over the world as a column that might support a certain form of public transportation. In order to categories the major trends in the pitches, this document's objective is to identify how the electric bicycle is being studied globally and, in particular, around which systematic provinces it is clustered. This research was conducted using the Scopus database, which included an analysis of all papers on the subject of electric bicycles published up to 2017. As a result, study on the current state of this topic's global research was done. Its development over time reveals that the growth of publications since 2008 has been significantly larger than in the earlier eras. China and the United States are the two main countries, and it can be assumed that there are two major developing nations with high levels of environmental responsiveness, a large population, and that the electric bicycle is an appropriate and practical mode of transportation for short- to medium-distance trips. This essay's primary goal is to give a notion regarding the creation and design of the electric bike.

1. Introduction :

When you peddle an electric bicycle, the (silent) motor turns on automatically. The two sorts of motors are those found in the rear hub and those found in the crank. While each type has advantages and disadvantages, mid drive systems have emerged as the superior choice in recent years. A bicycle having an integrated electric motor that may be used for propulsion is referred to as an electric bicycle, also known as an e-bike or booster bike. There are several different types of e-bikes available in the globe, ranging from peddles, which simply feature a modest motor to help the rider's pedal force, to somewhat more powerful e-bikes, which behave more like mopeds: However, none of them are electric motorcycles because the rider may still pedal them. The electric bicycle is an electrically assisted device that is intended to give electromagnetic momentums to an existing bicycle, relieving the operator of the burden of providing the energy required to operate the bicycle. It has a powerful engine and sufficient battery power that only has to be charged in order to aid in hill climbing, produce faster motoring speeds, and offer totally free electric

transportation. Compared to their gasoline-powered equivalents, electric vehicles cost more and perform worse. The idea is that since gasoline automobiles have benefited from a century of vigorous development, electric cars have mostly been ignored for a number of years.Even now, billions of dollars in research are spent on gasoline automobiles each year, while just a small portion of that money is spent on electric cars. Although air quality alone is not a sufficient rationale to mandate electric vehicles, it has been neglected for many years that this is the main reason why universities prefer them over gasoline-powered vehicles.

Fig 1 (Electric Bicycle)

2. LITERATURE REVIEW:

A hybrid system with a 50 cc carbureted lean-burn two-stroke engine and a 0.75 kW electric motor installed on the engine crankshaft was proposed by S. Matey and A. Prabhu in 2021. The electric motor's primary function was to improve torque during acceleration [1]. Su-Hau et al. (2004) proposed an integrated management system for electric motors with a focus on the battery's highly efficient energy utilization [2]. The innovative parallel-type hybrid-electric power system that David and Sheng-Chung (2004) presented includes an engine's energy distribution and a torque-integrated mechanism (more specifically, an engine, a motor/alternator, a CVT device, a PCM, and a 3-helical gear set) [3]. An strategy to controlling the power train of series hybrid electric vehicles was presented by Wenguang et al. in 2005. They suggested a system equation formulation and a controller design process. They also suggested a brand-new power converter switching strategy for controlling motor torque and motor flux [4].

3. Working Principle:

An e-bike is a bicycle with an electric assist motor. Similar to riding a regular bicycle, but with less effort. From commuter bikes to mountain bikes with full suspension and everything in between, e-bikes are available in a variety of forms.

Our attention is on urban and cargo bikes, which can be utilized for transportation, recreation, or both. To that purpose, we stock motorcycles that are high-quality, gorgeous to look at, and long-lasting. When you peddle an electric bicycle, the (silent) motor turns on automatically.

The two sorts of motors are those found in the rear hub and those found in the crank. While each type has advantages and disadvantages, mid drive systems have emerged as the superior choice in recent years.

Crank motors typically offer a more genuine bicycle feel. This is because the motor reacts proportionately to how much force you are applying to the pedals using a torque sensor (that is, the harder you pedal, the more the motor helps you). This gives the impression that your legs are very strong. Since there is no added drag from a motor in the hub, crank motors are typically more responsive than wheel hub motors and allow the bicycle to move more freely. We carry a number of e-bike models with Bosch and Shimano crank motors in stock. Wheel hub motors are more common and have an easier design.

Most wheel hub motors are either "on" or "off" since they cannot detect how much power you are producing with your legs. In addition to making tyre changes more challenging, having the motor in the back wheel also affects how well the bike handles because of the unbalanced weight distribution. We no longer carry hub-based electric systems due to these and other factors, with the exception of the amazing Brampton Electric bike.

4. Design & Description of components:

(1) Electric motor: Similar to other vehicles, an electric motor's power is expressed in kilowatts (kW). The performance of an electric motor, which can deliver its full torque across a wide RPM range, greatly exceeds that of a fuel-powered motor, which has a constrained torque curve, and is about equivalent to 134 horsepower (100 kW). Typically, alternating current (AC) is created by converting direct current (DC) electricity into AC electricity, which is then connected to a three-phase AC motor.

Fig (Electric Motor)

(2**) Component 2 (DC to AC converter**): The batteries in the vehicles are charged using the DC-to-AC Converters. These circuits are employed in solar power systems primarily for driving low-power AC motors. DC transmission lines can be utilised with the DC to AC converters to transmit electricity to loads.

Fig (DC to AC converter**)**

(2) Speed Controller: An electric bike's speed controller is an electronic circuit that dynamically brakes the bike in addition to controlling the speed of an electric motor. This controller unit feeds the motor with electricity that comes from the battery box. For brushing, various controller types are employed.

Fig (Speed Controller)

(3) Battery: For a specified voltage range, the majority of E-bike kits are rated. A battery that can generate between 42V and 80V of power is required for a normal 36V E-bike. Unassisted, a bicycle travelling at 25 mph will require 20 to 25 watts per mile. The bike will therefore travel 48 miles per charge assuming you receive 20 wh/mile. It will travel 38 miles per charge if it receives 25 wh/mile.

Fig (Battery)

5. Results and Discussions:

By using this method in a gym setting, more energy might be generated, which could then be stored in batteries and used to power other appliances. The maximum power produced by a pedal-operated stationary bicycle-based generator is 100–244 watts, compared to the manual treadmill's 14–W maximum power per user. The treadmill generator can produce energy, which can then be stored in batteries and used for a variety of purposes in the future. This energy producing mechanism is unaffected by negative attempts and is sustainable. The treadmill with an electricity generator uses less energy, saving you money. When the bike is in use, we can see that the gearing is altered to increase speed, similar to other treadmill bicycles. while using the exercise bike on the treadmill.The motion of the treadmill belt will drive the roller, the solar gear attached to it, and any additional mechanisms. Additionally, we discovered that the bicycle is simple to use and balance when running. The treadmill bike produces a vehicle that is quicker than walking and simpler to ride over short distances for exercise, while also measuring human safety.

6. Conclusions

E-bikes produce less pollution per mile than vehicles and motorbikes do. Using an electric bike instead of a gasoline or diesel vehicle can help. They consume energy at a rate of 100 to 150 watts on average as opposed to a car's 15,000 or so. Thus, this may contribute to bettering the air quality.

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Exemption upto 100% in Tuition fee for meritorious sports aspirants.
→ FOR OTHER STUDENTS :
Exemption upto 50% in Tuition fee for meritorious students at entry level only.*

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B.Tech	Computer Science & Engineering
B.Tech	Computer Science & Engineering (2nd Year Lateral Entry)
B.Tech	(CSE) Artificial Intelligence, Machine Learning & Deep Learning
B.Tech	2nd Year Lateral Entry (CSE) Specialization in Artificial Intelligence, Machine Learning & Deep Learning
M.Tech	Computer Science & Engineering
BCA	Bachelor of Computer Applications (Specialization in : Big Data & Visualization, Information Security & Cyber Security, Internet Technologies, Digital Marketing)
BCA	for Visually challenged
B.Sc.	(Hons.) Computer Science
B.Sc.	Cognitive Science
B.Sc.	Animation
MCA	Master of Computer Applications (Specialization in : Software Development, Machine Learning, Network Technologies, Data Science and Analytics, Advanced Technologies)
Ph.D	Computer Science & Engineering
Ph.D	Computer Applications

Collaboration with IBM

B.Tech	(CSE) Application Development using Cloud & Analytics Platform
B.Tech	2nd Year Lateral Entry (CSE) Application Development using Cloud & Analytics Platform

Collaboration with TCS iON

B.Tech	(CSE)Data Science (TCSion Industry Honour Program
B.Tech	2nd Year Lateral Entry (CSE)Data Science (TCSion Industry Honour Program

Collaboration with iNurture

B.Tech	Cloud Technology & Information Security (CTIS)
B.Tech	Data Science
B.Tech	2nd Year Lateral Entry (CSE) Data Science, CTIS
BCA	Mobile Applications & Web Technologies
BCA	Cloud Technology & Information Security

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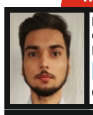

Dhairya Chauhan
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Infosys
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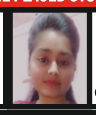
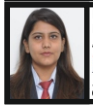


Megha Varshney
B.Tech., CSE(IBM)
SKYLARK LABS
9.00 Lakh



Pratiksha Kaushik
MCA
jaro education
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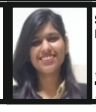

Shreya Gupta
B.Tech (CSE)
TATA
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150+ FACULTY MEMBERS
2500+ STUDENTS
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SCHOLARSHIP

→ FOR JAIN STUDENTS :
A. Exemption upto 50% in Tuition fee for entire duration of the programme.*
B. Exemption upto 40 % in Hostel fee (rooms with common bath only) for entire duration of the programme.*
→ FOR SPORTS ASPIRANTS :
Exemption upto 100% in Tuition fee for meritorious sports aspirants.
→ FOR OTHER STUDENTS :
Exemption upto 50% in Tuition fee for meritorious students at entry level only.*

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