



3.7.1.1: Total number of Collaborative activities per year for research/ faculty exchange/ student exchange/ internship/ on -the-job training/ project work

S. No	Name of the participant	Duration	Nature of the activity	Page No
- 20		2019-20		1
146.	Dr. Suresh Pabboju	01-01-2020	Research Publication	4
147	Ms K. Sugamya	01-03-2020	Research Publication	5
147.	Dr T. Pratima	18-03-2020	Research Publication	6
149	Mr. P. Vasanthsena	01-01-2019	Research Publication	7
150.	K Ramesh, S Shylaja, S Ramgopal, A Sambasiva Rao and KC Rajanna	28th June 2019 (4 Month)	Research	8
151.	Doddam SN, Peddireddy V, Yerra P, Arun PP, Qaria MA, Baddam R, Sarker N, Ahmed N	December 2019 (5 Month)	Research	9
152.	C. Nagendranatha Reddy, H.T.H. Nguyen, M.T. Noori, B. Min	November 2019 (6 Month)	Research	10
153.	DAMALLA DEEPIKA	20th - 30 th July 2020 (10 Days)	Internship	11
154.	GANGA DIVYA	7th july - 5th aug (4 Weeks)	Internship	13
155.	KOKU HANITHA REDDY	September 7 2020 - October 7 2020 (4 Weeks)	Internship	14
156.	K MAHITHA	25th July- 25th September 2020 (8 Weeks)	Internship	15
157.	NITIKA GIRIDHAR CHINTAMANE NI	14th Aug 2020 (6 months)	Internship	16
158.	PINNAPU REDDY RISHIKA REDDY	8th june - 8th aug 2020 (8 Weeks)	Internship	17
159.	GEEDIPALLY RISHISREE REDDY	10/09/20- 10/10/20 (4 Weeks)	Internship	18
160.	ROSHNI RAJ	1st june - 1st July 2020 (4 Weeks)	Internship	19
161.	DAKOOR SAI HARSHITHA	4th june - 4th july 2020 (4 Weeks)	Internship	20
162.	SOUMYA R SARAF	1st july - 31st Aug (4 Weeks)	Internship	22
163.	SRI LALITHA AMRITA GARLAPATI	20th - 30 th july 2020 (10 Days)	Internship	23

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166.	Akhil Kaundinya	25.05.2019 to 12.07.2019 (6 Weeks)	Internship	26
167.	V. Akhila Tejaswani,N. Pravallika,Y. Sneha Goud,Md. Ahmed,A. Prasoon Reddy,E. Sai Kiran,S. Sai Kiran,Ch. Sai Teja	30 days	Internship	27
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171.	Ravinder Reddy P, Sai Kiran C, Chandramouli G	4 Months	Research Publication	71
172.	G.Chandramouli, P.Ravinder Reddy, P.Laxminarayana, Mondeep Borthakur	4 Months	Research Publication	72
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g.A.m.

Principal Chaitanya Bharathi Institute of Technology (Autonomeus) Gandipet, Hyderabad-500 075.

Home > Molecular Cell Biology > Biological Science > Cellular Processess > Secretion

#### Chapter

Text Steganography: Design and Implementation of a Secure and Secret Message Sharing System

#### January 2020

#### DOI:10.1007/978-3-030-24322-7\_58

In book: Advances in Decision Sciences, Image Processing, Security and Computer Vision (pp.470-479)

#### Authors:



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Home > Elementary Education > Education > Handwriting PDF Available Chapter Realistic Handwriting Generation Using Recurrent Neural Networks and Long Short-Term Networks March 2020 DOI:10.1007/978-981-15-1480-7\_55 In book: Proceedings of the Third International Conference on Computational Intelligence and Informatics (pp.651-661) Authors: Suraj Bodapati Sugamya Katta Sneha Reddy University at Buffalo, The State University of New York Chaitanya Bharathi Institute of Technology Download full-text PDF Read full-text ↓ Download citation Opy link  $\sim$ Citations (1) References (7) Figures (6) Abstract and Figures Generating human-like handwriting by machine from an input text given by the user may seem as an easy task but is very complex in reality. It might not be possible for every **Discover the** • 20+ million human being to write in perfect cursive handwriting because each letter in cursive gets world's research members shaped differently depending on what letters surround it, and everyone has a different • 135+ style of writing. This makes it very difficult to mimic a person's cursive style handwriting millior with the help of a machine or even by hand for a matter of fact. This is why signing Join for free names in cursive is preferable on any legal documents. In this paper, we will try to use various deep learning methods to generate human-like handwriting. Algorithms using • 700k+ neural networks enable us to achieve this task, and hence, recurrent neural networks research (RNN) have been utilized with the aim of generating human-like handwriting. We will projects discuss the generation of realistic handwriting from the IAM Handwriting Database and check the accuracy of our own implementation. This feat can be achieved by using a special kind of recurrent neural network (RNN), the Long Short-Term Memory networks (LSTM). +1 Model overview Heat map by Modified LSTM Recurrent model Phis plot stacking soft... State vector to feedforward... Figures - uploaded by Sugamya Katta Author content Contant may be aubient to convict





Proceedings of the Third International Conference on Computational Intelligence and Informatics pp 627–637

## Rough Set-Based Classification of Audio Data

T. Prathima 🗠, <u>A. Govardhan</u> & <u>Y. Ramadevi</u>

Conference paper | First Online: 18 March 2020

477 Accesses

Part of the <u>Advances in Intelligent Systems and Computing</u> book series (AISC,volume 1090)

#### Abstract

For effective multimedia content, retrieval audio data plays an important role. Recognising classes of audio data which is neither music nor speech is a challenging task; in this aspect, the authors proposed to work on environment sounds. To represent the audio data, low-level features are extracted. These low-level descriptors are computed from both time domain and frequency

#### Chapter

An Optimal Heuristic for Student Failure Detection and Diagnosis in the Sathvahana Educational Community Using WEKA: Proceedings of the International Conference on Communications and Cyber Physical Engineering 2018

January 2019 · Lecture Notes in Electrical Engineering

DOI:10.1007/978-981-13-0212-1\_68

In book: ICCCE 2018 (pp.671-678)

#### Authors:



#### Vasanth Sena

Chaitanya Bharathi Institute of Technology



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Porika Sammulal

J To read the full-text of this research, you can request a copy directly from the authors.

#### References (8)

#### Abstract

The study offered in this paper aims to explore students characteristics and to determine unsuccessful student groups in respective subjects based on their earlier education and the impact of other factors in multiple dimensions. Predictive data mining techniques such as as classification analysis is applied in the analysis process. Datasets used in the investigation were collected from

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 700k+ research



# Poly(ethylene glycol) Supported Metal Nitrates as Well-Organized Reagents for Hunsdiecker Conversion of $\alpha,\beta$ -Unsaturated Acids to $\beta$ -Nitrostyrenes under Solvent and Acid-Free Conditions

#### K. RAMESH<sup>1</sup>, S. SHYLAJA<sup>1</sup>, S. RAMGOPAL<sup>2</sup>, A. SAMBASHIVA RAO<sup>3</sup> and K.C. RAJANNA<sup>2\*</sup>

<sup>1</sup>Department of Chemistry, Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad-500075, India <sup>2</sup>Department of Chemistry, Osmania University, Hyderabad-500001, India <sup>3</sup>Department of Chemistry, M.V.S.R. Engineering College, Hyderabad-501510, India

\*Corresponding author: E-mail: kcrajannaou@yahoo.com

 Received: 2 February 2019;
 Accepted: 9 April 2019;
 Published online: 28 June 2019;
 AJC-19454

 Poly(ethylene glycol) (PEG) supported metal nitrates such as ferric nitrate and manganese nitrate were accomplished as well-organized reagents for Hunsdicker conversion of α,β-unsaturated acids to β-nitrostyrenes under acid-free and solvent free conditions using grind-stone technique. However, in the case of unsaturated aliphatic acids, nitro alkene derivatives were obtained as products. PEG-400 was

Keywords: PEG supported metal nitrates, β-Nitrostyrenes, α,β-Unsaturated acids, Hunsdiecker conversion.

found the best among the other PEGs (PEG-200,300, 400, 600, 3000 and 6000) used in this protocol.

#### INTRODUCTION

#### EXPERIMENTAL

Solvent and acid free organic synthesis captured the attention of chemistry community all over the world because of their importance to prevent environmental pollution, improve green reaction conditions followed by enhanced selectivity [1-11]. Stimulated by these striking features coupled with other green-chemistry principles we too have focused our attention to design, improve and execute green synthetic protocols [12-20]. In previous publication [19] we reported the synthesis of  $\beta$ -nitrostyrenes and nitroalkenes respectively from  $\alpha,\beta$ - Grind-stone method of  $\beta$ -nitro styrene synthesis: Known amounts of unsaturated acid (0.1 mol), PEG (0.02 mol) and Fe(III) or Mn(II) nitrate (0.12 mol) were taken in a mortar and ground with a pestle till the reaction mixture became homogeneous. After completion of the reaction, as confirmed by TLC, about 2 % Na<sub>2</sub>CO<sub>3</sub> solution was added to the reaction mixture till it is neutralized. Reaction product was extracted by dichloromethane (DCM) or dichloroethane (DCE), dried with sodium sulfate and purified by column chromatography. Binary solvent

#### (i) Chaitanya Bharathi Institute of Technology does not subscribe to this content.



International Journal of Medical Microbiology Volume 309, Issue 8, December 2019, 151353

Mycobacterium tuberculosis DosR regulon gene

Rv2004c contributes to streptomycin resistance

Sankara Narayana Doddam \*, <sup>1</sup>, Vidyullatha Peddireddy \*, <sup>6</sup> 🎗 🖾, Priyadarshini Yerra \*, PV Parvati Sai Arun <sup>c</sup>

and intracellular survival

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https://doi.org/10.1016/j.jjmm.2019.151353

, Majjid A. Qaria <sup>a</sup>, Ramani Baddam <sup>d</sup>, Nishat Sarker <sup>d</sup>, Niyaz Ahmed <sup>a, d</sup> 🞗 🖾



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Bioresource Technology Volume 292, November 2019, 122010



Potential applications of algae in the cathode of microbial fuel cells for enhanced electricity generation with simultaneous nutrient removal and algae biorefinery: Current status and future perspectives

C. Nagendranatha Reddy <sup>a, b, c</sup>, Hai T.H. Nguyen <sup>a</sup>, Md T. Noori <sup>a</sup>, Boold Min <sup>a</sup> A ⊠ Show more ∨ + Add to Mendeley e<sup>o</sup><sub>0</sub> Share 55 Cite https://doi.org/10.1016/j.biortech.2019.122010 Get rights and content



# INTERNSHIP CERTIFICATE

This is to certify that



B.Tech Biotechnology of Chaitanya Bharathi Institute of Technology, Hyderabad has completed the 10 days "Internship Program on Nanotechnology" organized by the Institute of Innovations, Tiruvannmalai during 20-30 July 2020. We found her sincere, hardworking, dedicated and result oriented. She had passed in the final evaluation test.
 We take this opportunity to thank her and wish her all the best for her future. Awarded this 2<sup>nd</sup> August 2020

Regards,

Ppromeen dhow

R. Praveen Kumar Managing Director Institute of Innovations

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# CERTIFICATE of Internship

This certificate is proudly presented to

# HANITHA REDDY

In recognition of outstanding accomplishments and contributions for the International Model United Nations Campus Ambassador internship programme. Her hard-work, talent and dedication has been instrumental in achieving the goals of the Campus Ambassador department.

This internship was from September 7th, 2020 till October 7th, 2020

Best Of

IMUN

Mohineesh Bhardwy

Mohneesh Bhardwaj Executive Chairman



# **Edvizo Media Private Limited**

Certificate of Appreciation

This is to certify that **Ms. Mahitha Kasturi** has served as a **Social Media Marketing Intern** in the Marketing team and has successfully completed three months long part-time internship program at this organization. Her hard work and dedication to the assigned tasks is greatly appreciated and acknowledged.

Ullas M S (Ullas M S) Outreach Officer

Dated the 25<sup>th</sup> September, 2020



ISO 9001 and ISO 27001 Certified

7<sup>th</sup> August 2020

# Ms. Nitika Giridhar Chintamaneni,

Flat No: 400, Legend Apex Apts, Plot No: 28A, MLA Colony, Road No: 12, Banjara Hills, Hyderabad - 34.

# Dear Nitika,

# Sub: Offer of Internship

We are pleased to inform you that you have been provisionally selected as intern for the post of Marketing Manager.

You are required to report in person on 14<sup>th</sup> August 2020 with this letter and also bring all the applicable documents along with you as mentioned in Joining Requirements, in this letter at the below mentioned address:

# **Promantra Synergy Solutions Ltd**

6-3-698/A, 2nd Floor, Pawani Plaza, Panjagutta, Hyderabad – 500 082.

# **Documents Required on the Date of Joining:**

You are required to contact HR department on the date of your joining. You would be required to bring the following:

- Certificates of educational qualifications (SSC, Intermediate, Degree, Post Graduation)
- 2. last 3 months pay slip
- 3. Service certificate from all previous employers
- Relieving letter from all previous employers
- Form 16 or Taxable income statement from last employer
- 5 Nos. recent passport size photographs
- 7. Copy of the PAN Card
- 8. Copy of the Passport

During your internship we will pay stipend of Rs.10,000 per month with standard deductions.

We are pleased to invite you to be a part of **Promantra** and look forward to a long and successful association with you.

Sincerely yours, For Promantra Synergy Solutions Ltd.

Ch. Sarada Raj Sr Manager - HR

Nitita

**Acceptance Signature** 

Cell: 98666 56004

# LAKSHMI POLYMERS

Plot No. 29, Phase 3, IDA, Pashamylaram, Medak Dist.

Date:....

Dt: 14/08/2020

### INTERNSHIP CERTIFICATE

This is to certify that Ms. P. Rishika Reddy has successfully completed her internship with Lakshmi Polymers, Hyderabad with a role of Marketing Manager for our product of polypropylene strap (pp strap) for a period of Two (2) months from 8/06/2020 to 8/08/2020. During the time period she was innovative with marketing techniques for our product.

During her internship she played a vital role and she presented herself in organized way to achieve the tasks in targeted time. She is hardworking and we appreciate her self-motivated skills to learn the new activities.

Her performance is upto the expected levels and we wish her all the best for future endeavours.

For Lakshmi Polymers

and in

Proprietor

Ref. :

1 1 13



# WOMENITE

#### (Registered Under the Society Registration Act. XXI of 1860)

Office: NS-7, Upper ground floor, Mianwali Nagar, New Delhi – 110087

#### 11th October 2020

#### TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Geedipally Rishisree Reddy** is hereby recognized for working with Womenite as an **intern** in the **Social media marketing** team from **10/09/20** till **10/10/20**.

She has helped in promoting Womenite's cause through various social media platforms like Facebook, Instagram, Twitter and LinkedIn. She also contributed to increase the social media presence of Womenite.

We were impressed with the commitment, exertion and ownership shown. We congratulate her for successful completion of her term and wish her a great career ahead.

Best Regards,

Jarshit

Harshit Gupta (Founder, Womenite)

Womenite aims to create an equal society through education, love and empowerment.







MODEL UNITED NATIONS



Australian Embassy

Vietnam & Thailand

Certificate of Internship

This Certificate Recognizes with Appreciation

# **ROSHNI RAJ**

As a Campus Ambassador Intern for

#### INTERNATIONAL MODEL UNITED NATIONS

from June 1st, 2020 - July 1st, 2020

Mohinecsh Bhooding

Mohneesh Bhardwaj Executive Chairman

# Exposys Data Labs



#### Certificate of Internship

TO WHOM IT MAY CONCERN

This is to certify that **Ms. D Sai Harshitha** has completed internship programme on **"Content Writer**" from 04.06.2020 to 04.07.2020.

She took keen interest in the work assigned and successfully completed it. During the period of internship we found her to be punctual, hardworking and inquisitive.

We wish her luck and success in all her future endeavours.

Y Vishnuvardhan

Chief Director



hr@exposysdata.com www.exposysdata.com







# INTERNSHIP CERTIFICATE

This is to certify that



# Ms. Sri Lalitha Amrita Garlapati

B.Tech Biotechnology of Chaitanya Bharathi Institute of Technology, Hyderabad has completed the 10 days "Internship Program on Nanotechnology" organized by the Institute of Innovations, Tiruvannmalai during 20-30 July 2020. We found her sincere, hardworking, deidcated and result oriented. She had passed in the final evaluation test.
 We take this opportunity to thank her and wish her all the best for her future. Awarded this 2<sup>nd</sup> August 2020

Regards,

Pproven dhim

R. Praveen Kumar Managing Director Institute of Innovations

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17th Sept, 2020

## TO WHOMSOEVER IT MAY CONCERN

This certificate is presented to Poduri Swaraj Neeharika in recognition of outstanding accomplishments and contributions for the Lalimber Marketing Internship Program for 1 month.

Swaraj has shown great promise as a marketing intern and has a very strong work ethic.

Swaraj's work has been highly appreciated.

We wish her all the success in life.

With best wishes,

SHIVANSHU PALIYA (CEO)



Indian Institute of Food Processing Technology

(Ministry of Food Processing Industries, Government of India) Pudukkottai Road, Thanjavur - 613 005, Tamil Nadu M 💿 F P I

# **e-CERTIFICATE** PARTICIPATION

This is to certify that **VAISHNAVI EDARA** has undergone **Two Weeks Online Internship Programme for Students on Food Processing Technology: Advances & Applications** organized by the **Department of Technology Dissemination, Indian Institute of Food Processing Technology (IIFPT)** from 3<sup>rd</sup> August 2020 to 14<sup>th</sup> August 2020.

Date: 14.08.2020

**Programme Coordinator** 



#### HR/INTERNSHIP/CERT/99992099/2019

Date: 12.07.2019

#### CERTIFICATE

This is to certify that Mr. Akhil Kaundinya, student of 7<sup>th</sup> Semester Chaitanya Bharathi Institute of Technology has successfully completed his internship at TATA Motors Ltd, Pune from 25.05.2019 to 12.07.2019.

During the above period, he was placed in Die Design, Production Engineering.

He has studied on following project:

Design of Long Member Templates.

He was found to be enthusiastic and observant during the above period. His performance has been assessed as Good.

For TATA MOTORS Ltd.

Bestisting

Shivram Krishnan DGM (Human Resource)

#### TATA MOTORS LIMITED

Pimpri Pune 411 018 Tel 91 20 6612 1111

Registered Office Bombay House 24 Promit Mody Street Mumbar 105 p.1.

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**M**Ctara

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Acrem Subor, IRAS Additional Director

Date Sain 2019

TO

The Principals Chaitanya Bharothi Institute of Technology, Gandipet, Hyderabad

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#### CERTIFICATE OF INTERNSHIP

This is to certify that Ms V Akhila Teleswant, Boll No. 160118672001 pursuing MBA(Finance) in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Indian Railway Working capital management". Irom 04.06.2019 to 15.07.2019.

(KORAM KISHOR)



Date: 23rd July 2019

#### **CERTIFICATE OF EXPERIENCE**

This is to certify that Ms. M.V.N Archana has done Internship at **Bilwam India Technologies Pvt. Ltd.** from 01<sup>st</sup> June 2019 to 30<sup>th</sup> June 2019 on marketing under the guidance of Mr. Naresh

We have found him to be a self starter who is motivated, duty bound and hard working.

She worked sincerely on his assignments and his performance was Par Excellence.

We wish him best of luck for his future.

For Bilwam India Technologies Pvt Ltd





Level 10, SLN Terminus, Survey No. 133, Beside Botanical Gardens Gachibowli, Hyderabad - 500 032, India. Tel: +91 40 67900000 Fax: +91 40 67900299 www.mamottexecutiveapartmentshyderabad.com



July 06, 2019

#### CERTIFICATE

This is to certify that Ms. P Ashmitha Singh of Chaitanya Bharathi Institute of Technology has trained at Marriott Executive Apartments, Hyderabad. from 06<sup>th</sup> June 2019 To 06<sup>th</sup> July 2019, in Finance Department.

Her overall conduct during her traineeship was Good.

We wish her all the best for her future endeavors.

For MARRIOTT EXECUTIVE APARTMENTS, HYDERABAD

Bharadwai Human Resources Manager DERABAD

「「ない





# Certificate of Internship WE PRESENT THIS CERTIFICATE TO

ARJULA CHAITHANYA

A.T. &ML IN APPRECIATION FOR YOUR SUCCESSFUL WORK AS AN INTERN ON \_ THE INTERNSHIP WAS CONDUCTED BETWEEN 10-06-2019 AND 06-07-2019

0'

Sundeep Kumar Makthala Chairman, Digithon\*

06-07-2019

DATE :

Quality Care India Limited



Date: 09/07/2019

#### TO WHOM SO EVER IT MAY CONCERN

This is to certify that Ms. Gaddam Harini, student of "Chaitanya Bharathi Institute of Technology" successfully completed her internship in our organization in the department of Human Resources from 01/06/2019 to 30/06/2019.

for Quality CARE India Limited

Mr. V Anil Rumar Dy. Manager-HR

NAMPALLY, Emiliation month M.J. Marikel, Numpally, Hydera ad 500001. Phi 040-30117777, Fax: 040-30417488 BANJARA HILLS: North M.J. Marikel, Numpally, Hydera bad 34. T. 190-30419808, Fax: 040-30418688; HI-TECH CITY: On Monical Highway, Near Constructor, out 10 minisate strate, Hyderabids 32, Phi +91-40-33623500, HYDERABAD, Musheerabad, Tel +91-40-3021 9000, Secure strabad; oi: +91-40-3043 6666; BHUBANESWAR: Tel +91-574-3268 746 NAGPUR: Tel +91-12-398; 222, PUNE; Tel +91-20-2745 6496; RAIPUR: Tel +91-771-2419 193, VISAKHAPATNAM; Tel -91-391-304, 444

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Date: 23# July 2019

#### **CERTIFICATE OF EXPERIENCE**

This is to certify that Ms. Kasak Sharma has done Internship at **Bilwam India Technologies Pvt. Ltd.** from 01<sup>st</sup> June 2019 to 30<sup>th</sup> June 2019 on marketing under the guidance of Mr. Naresh

We have found him to be a self starter who is motivated, duty bound and hard working.

She worked sincerely on his assignments and his performance was Par Excellence.

We wish him best of luck for his future.

For Bilwam India Technologies Pvt. Ltd.

Sr Human Resources





**Experts Gamers** 

#### TO WHOMSOEVER IT MAY CONCERN

#### Date: August 31, 2019

This is to certify that Ms. Meghana Gugloth has successfully completed her internship with GetMega as Marketing Intern for a period of 1 month.

During the period, she helped the team with research and content of different games. She worked on different modules of company projects, campaigns and advertisements to increase the number of users on the application.

During her association with GetMega, Ms. Meghana Gugloth has shown great amount of responsibility, sincerity and a genuine willingness to learn and zeal to take on new assignments and challenges. In particular, her coordination skills and communication skills are par excellence and her attention to details is impressive.

We wish her all the very best for her future.

With regards, Siddhant Vats Community Manager, GetMega For MEGASHOTS INTERNET PYT. LTD. Budune alog-Authorised Sharetory

Megashots Internet Private Limited 31, 32 & 37, K.No.25, Roopena Agrahara, BANGALORE, Bangalore, Karnataka, India, 560668 CIN: U72900KA2018PTC116707 ຮູ້ ເກລຸມລິດຜູ້ເກີງເມດໃນພົບຂ







**ស៊ាខា្លូទើ ស៊ីខា សិស្ត្**តិស្ត្ ( We are ISO 9001 : 2015 Certified )

# Plet No. 94/A, Phase - II, Sector-II, Lane No. 17, IDA, Cherlapally, Hyderabad - 500 051. Medchal Dist., Telangana State, INDIA E-mail : harshinits@gmail.com, m.muralidharbabu@gmail.com Website: www.harshinitelesystems.com

Date: 28/06/2019

#### TO WHOM IT MAY CONCERN

This is to certify that Miss. Kongara Niharika, D/o. Mr. K. Srinivasa Rao, a student of MBA, Chaitanya Bharathi Institute of Technology, Hyderabad has successfully completed one month internship programme (from 28/05/2019 to 28/06/2019) at this company. During the period of her internship programme with us she was found punctual and inquisitive.

We wish her every success in life.

HARSI

For, Harshini Tele Systems(

M. Muralidhar Babu Proprietor





MINISTRY OF RAILWAYS, GOVERNMENT OF INDIA

Koram Kishor, IRAS Additional Director

Date: 18.09.2019

To

The Principal Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad

Sir,

#### CERTIFICATE OF INTERNSHIP

This is to certify that Ms N Pravallika, Roll No. 160118672013 pursuing MBA(Finance) in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Indian Railway Working capital management" from 04.06.2019 to 15.07.2019.

(KORAM KISHOR)



Date : July 6, 2019

#### TO WHOMSOEVER IT MAY CONCERN

This is to certify that Ms. B. Praveena student from CBIT, Hyderabad, India has done her Internship from our Organization. "Sresta Natural Bioproducts Pvt Ltd" from 07/06/2018 to 06/07/2018, under guidance of Ms. Kornal Garg Agarwal in HR Department.

She was found to be sincere & hard working during her tenure.

We wish her all the best for her future endeavours.

For Sresta Natural Bioproducts Pvt Ltd

Ptat

N.Balasubramania'n CEO



#### Sresta Natural Bioproducts Pvt. Ltd.

Corporate Office : Sresia House H No 8-2-468/A/1/2, 2nd & 3rd Floor Road No -5, Banjara Hills, Hyderabad - 500 034 Tel : +91 40 40072525/26/28, Fax +91 40 40072527, E-mail : info@sresta.com Website www.sresta.com CIN - U01122TG2004PTC042837

Regd. Office : 203, Pavani Annexe, # 8-2-276, Road No. 2, Banjara Hills, Hyderabad - 500 634, A P. India.

Scanned by CamScanner


Weekend Creations Private Limited G-16/13, DLF Phase-1, Gurugram, Haryana-122002

www.hrhelpdesk.in Phone: 0124-4007444

2<sup>nd</sup> June, 2018

To Whomsoever It May Concern

This is to certify that P Shanmuka Priya has successfully completed her internship with HRhelpdesk® from 5<sup>th</sup> April 2018 to 30<sup>th</sup> May 2018. During her internship for the MahilaBol campaign, she completed the assigned tasks of conducting the survey amongst working women on gender development, mainstreaming and work environment.

The MahilaBol survey is a national survey across sectors and locations in India and is in-line with the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013. It is an initiative of Ministry of Women and Child Development, Government of India, and UN Women, India.

During the above period, P Shanmuka Priya took keen interest in the assigned activities and we hope that her efforts will help create a change in the society. She has been found hardworking and dedicated.

We wish her success in the future endeavours.

Sincerely,

Manufet Kaur

Manmeet Kaur Business Associate- Internal HR



July 18th, 2019

### TO WHOM IT MAY CONCERN

This is to certify that Ms. Shashanka Kunchapu, successfully completed 45days (from 27<sup>th</sup> May 2019 to 12<sup>th</sup> July 2019) internship at Tutoroot Technologies Pvt Ltd.

Her Responsibilities during Internship includes:

- Calling on the leads and scheduling on demo with the students/parents
- Understand customer profile & problems to explain implication of ineffective traditional learning methods
- To guide and counsel students/parents on the advantages of personalized online tutoring
- Good in managing sales cycle: Prospecting, Counselling, Product Demonstration, Pricing and after Sales Support
- Maintaining healthy relations with all paid students/parents and keeping track of renewal accounts
- Co-ordinate with the operations team to ensure smooth delivery of the scheduled classes
- Building strong student data base by generating new and referral leads
- Reporting of daily activities status including follow ups, pipeline cases and expected payments

During the period of her internship program with us she had been exposed to different process was found punctual, hardworking and inquisitive.

We wish her all the best in her future endeavours.

### For Tutoroot Technologies Pvt Ltd

Uma Mahesh Murty Manager - HR



# Tutoroot Technologies Private Limited.

CIN: U80904TG2018FTC125724 Read, Dff INCC Building, 3rd Floor, Western Wing, Machapur, Hyderabad 500081, INDIA Ph + (91)40.23119633 | www.uttoroot.com | Family 54, 55



Toppr Technologies Pvt. Ltd. A204, Supreme Business Park. Hiranandani, Powal, Mumbal - 400076 CIN No: U80904MH2013PTC241592

26<sup>th</sup> July, 2019

### To Whom It May Concern

This is to certify that Ms. Meghavath Shravani was working with our organisation as an Intern from 12<sup>th</sup> June 2019 and has been relieved of her duties effective 31<sup>st</sup> July 2019.

During her employment with us, we have found her to be hard working, diligent and honest in performing her duties.

The management would like to thank her for her service with the company and wish her all the best in future endeavours.

For Toppr Technologies Pvt. Ltd.

K Balanagendra Babu

Asst. Manager- HR





Win Botton





AINISTRY OF RAILWAYS, GOVERNMENT OF IND A

Koram Kishor, IRAS Additional Director Date: 18.09.2019

To

The Principal Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad

Sir,

### CERTIFICATE OF INTERNSHIP

This is to certify that Ms Sneha Goud, Roll No. 160118672022 pursuing MBA(Finance) in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Capital budgeting in Indian Railways" from 04.06.2019 to 15.07.2019.

(KORAM KISHOR)

### Praveen Jain & Associates Chartered Accountants

### EXPERIENCE - CERTIFICATE

### TO WHOM SO EVER IT MAY CONCERN

It is to certify that Ms. S Sri Harshitha S/o S Srinivas Reddy was working as an intern with our firm - M/s Praveen Jain & Associates, Chartered Accountants from period May 29<sup>th</sup>, 2019 till July 3<sup>rd</sup>, 2019 as per the firm's employment record.

During her employment she has perused knowledge & experience in field of Finance / Taxation, etc. from our organisation.

During her employment we found her to be Professional, knowledgeable and result oriented with theoretical & practical understanding of work requirements.

Overall Ms. S Sri Harshitha, performed her duties and responsibilities cheerfully with attention to detail at all times. With her enthusiasm to work, learn and progress, I am certain that she would make a great employee to any enterprise.

We wish her all the best in her future endeavor.

For Praveen Jain Associates Chartered Accountants,

Reavent

Praveen Jain Proprietor Place : Hyderabad Date : 04/07/2019

Address: 2-2-1107/A/8/1, Tilak Nagar, Hyderabad, T.G - 500044 email: praveenjain22@gmail.com, Telephone: 040-65941560





MINISTRY OF RAILWAYS, GOVERNMENT OF INDIA

Koram Kishor, IRAS Additional Director

Date: 26.09.2019

To

Are Principal Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad

Sir,

### CERTIFICATE OF INTERNSHIP

This is to certify that Mr Auquib Ahammad, Roll No. 160118672033 pursuing MBA(Finance) in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Working capital management in Indian Railways" from 04.06.2019 to 15.07.2019.

(KORAM KISHOR)

22

CENTRALISED TRAINING ACADEMY FOR RAILWAY ACCOUNTS, TARNAKA, SECUNDERABAD. 500 017 PHONE: 040 27000040 FAX:27001359



# SRIVIDHYA AND ASSOCIATES Chartered Accountants

# TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. KARTHIK KUMAR REDDY Y (Reg no.: 1601-18-672-030), pursuing MBA at Chaitanya Bharathi Institute of Technology, Hyderabad, has completed his internship program with our firm from 01<sup>st</sup> June 2019 till 10<sup>th</sup> July 2019 under Finance department.

His overall conduct during the program was very good and he was found to be sincere and dedicated towards work throughout the tenure.

M.No: 243874

We wish him all the best for his future endeavours.

Place: Hyderabad Date: 12<sup>th</sup> July 2019

For SRIVIDHYA AND ASSOCIATES Chartered Accountants

CA SRIVIDHYA DUBALA (Proprietor) M.No.: 243874

Q Le

22

VALIOSO ADVISORY SERVICES PRIVATE LIMITED

CIN: U74999TG2017PTC114336

GST: 36AAFCV7831G1Z4

Date: 16-Jul-2019

Ref: VAS/2019/Internship-02

### TO WHOMSOEVER IT MAY CONCERN

This is to certify Madhu Sudhan Reddy M [Reg. No. 1601-18-672-031] pursuing MBA from Chaitanya Bharathi Institute to Technology, Hyderabad, has successfully completed his internship project in our organization from 07<sup>th</sup> Jun, 2019 to 01<sup>st</sup> Jul, 2019. During his period of internship programme, he was found to be hardworking and interested to learn from the assigned project study.

We wish him all the best for his future endeavours.

Regards Aditya Jak Director



S Technologies Pvt Ltd. You Imagine We Bring to Life

### **EXPERIENCE LETTER**

13-07-2019

### To Whom It May Concern

This letter is to certify that Kavati Mahesh Kumar has successfully completed his internship program of 45 days with MKS Technologies Pvt Ltd. His internship tenure was from 29<sup>th</sup> May 2019 to 13<sup>th</sup> July 2019. He was working as Digital Marketing Executive in Marketing Department and was actively & diligently involved in the tasks assigned to him.

During the span, we found him punctual, self-learning and hardworking person. His learning powers are good and he picks up swiftly. His feedback and evaluation proved that he learned keenly. Moreover, his interpersonal and communication skills are brilliant.

We wish him a bright future.

Sincerely,

For MKS Technologies : ilvalu .... K-Sevalalczhmi

Siva Lakshmi

Manadine Director | Director

Director

MKS Technologies Pvt Ltd

VALIOSO ADVISORY SERVICES PRIVATE LIMITED

CIN: U74999TG2017PTC114336

GST: 36AAFCV7831 61Z4

Date: 16-Jul-2019

Ref: VAS/2019/Internship-01

### TO WHOMSOEVER IT MAY CONCERN

This is to certify Mohammad Meera Shariff [Reg. No. 1601-18-672-034] pursuing MBA from Chaitanya Bharathi Institute of Technology, Hyderabad, has successfully completed his internship project in our organization from 14<sup>th</sup> Jun, 2019 to 08<sup>th</sup> Jul, 2019. During his period of internship programme, he was found to be hardworking and interested to learn from the assigned project study.

We wish him all the best for his future endeavours.

Regards Secunderabac Aditya Jak Director



# Ctara

MINISTRY OF RAILWAYS, GOVERNMENT OF INDIA

Koram Kishor, IRAS Additional Director

Date: 18.09.2019

To

The Principal Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad

Sir,

CERTIFICATE OF INTERNSHIP

This is to certify that Mr A Prasoon Reddy, Roll No. 160118672040 pursuing. MBA(Finance) in Chaltanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Indian Railway Working capital management" from 04.06.2019 to 15.07.2019.

(KORAM KISHOR)

CENTRALISED TRAINING ACADEMY FOR RAILWAY ACCOUNTS, TARNAKA, SECUNDERABAD, 500 017 PHONE: 040 27000040 FAX:27001359 9/23/2019





MINISTRY OF RAILWAYS, GOVERNMENT OF LILLA

Koram Kishor, IRAS Additional Director Date: 18.09.2019

To

The Principal Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad

Sir,

### **CERTIFICATE OF INTERNSHIP**

This is to certify that Mr E Sai Kiran, Roll No. 160118672042 pursuing MBA(Finance) in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Capital budgeting in Indian Railways" from 04.06.2019 to 15.07.2019.

(KORAM KISHOR)



E/Ctara

Construction of the state of

Renaux Eishor IRAS

To

The Paral man Charlongs Bhan dis Institute on Technology Gradies - Hyderaland

### CERTIFICATE OF INTERNSHIP

This is to certify that Mr S Sai Kiran, Roll No. 160118672043 pursuing MBA(Finance in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Capital budgeting in Indian Railways" from 04.06.2019 to 15.07.2019.

(KORAWI KISHORI

CENTRALISED TRAINING ACADEMY FOR RAILWAY ACCOUNTS, TARNAKA, SECUNDERABAD, 500 017 PHONE, 0/0 27000040 FAX: 27001359





A AMINAIS COVERSIST .

Koram Kishor, IRAS Additional Director Date: 18.09.2019

TR

The Principal Chaitanya Bharathi Institute of Technology, Gandipet, Hyderabad

Sir,

### CERTIFICATE OF INTERNSHIP

This is to certify that Mr Chanda Sai Teja, Roll No. 160118672044 pursuing MBA(Finance) in Chaitanya Bharathi Institute of Technology, Hyderabad has undergone INTERNSHIP in Ctara into the working of Finance and Accounts of Indian Railways with reference to the topic "Capital budgeting in Indian Railways" from 04.06.2019 to 15.07.2019.

(KORÁM KISHOR)





Date: 27-05-2019

### K SREEKANTH

FIK E-COMMERCE PVT. LTD

Hyderabad

### Subject: DIGITAL MARKETING INTERNSHIP LETTER

### Dear Mr. K SREEKANTH

This is in response to your application for internship on "DIGITAL MARKETING" with FIK E-Commerce Pvt. Ltd. We would like to extent heartiest congratulations on your selection for internship with FIK E-Commerce Pvt. Ltd. based at Hyderabad for a duration of One month. Your internship started from May 27<sup>th</sup>, 2019 and completed on June 26<sup>th</sup>, 2019.

During your internship, you were trained on "GOOGLE ADWORDS" both theoretically and practically over a period of 30days.

Given below is the address where you are for internship:

FIK E-COMMERCE PVT LTD, PLOT NO : 101 & 106, 1ST FLOOR RELIANCE CYBER VILLE, VITTAL RAO NAGAR, MADHAPUR HYDERABAD - 500081, INDIA

Best wishes for your bright future.

Regards,



FIK E-COMMERCE PVT. LTD

FIK E-commerce Private Limited Plot no. 101&106, 1<sup>st</sup> Floor, Reliance Cyber Ville, Vittal Rao Nagar, Madhapur, Hyderabad, Telangana.500081, Tel: 040-48521939 Mobile: +91 7997996949 http://www.fikweb.com/



Date: 23rd July 20:

### **CERTIFICATE OF EXPERIENCE**

This is to certify that Mr. A.Vamshi Krishna has done Internship at Bilwam India Technologies Pvt. Ltd. from 01<sup>a</sup> June 2019 to 30<sup>th</sup> June 2019 on marketing under the guidance of Mr. Naresh

We have found him to be a self starter who is motivated, duty bound and hard working.

He worked sincerely on his assignments and his performance was Par Excellence.

We wish him best of luck for his future.





# SRIVIDHYA AND ASSOCIATES

Chartered Accountants

### TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. VIJAY KUMAR REDDY G (Reg no.: 1601-18-672-055), pursuing MBA at Chaitanya Bharathi Institute of Technology, Hyderabad, has completed his internship program with our firm from 01<sup>st</sup> June 2019 till 10<sup>th</sup> July 2019 under Finance department.

His overall conduct during the program was very good and he was found to be sincere and dedicated towards learning new things and gaining practical knowledge in the areas of Finance.

We wish him all the best for his future endeavours.

Place: Hyderabad Date: 12<sup>th</sup> July 2019

For SRIVIDHYA AND ASSOCIATES hartered Accountants VIDHYA DUBALA (Proprietor) M.No.: 243874



# Certificate of Internship

WE PRESENT THIS CERTIFICATE TO

DAMA VYBHAV KUMAR

JMS I.A IN APPRECIATION FOR YOUR SUCCESSFUL WORK AS AN INTERN ON.

06-07-2019 THE INTERNSHIP WAS CONDUCTED BETWEEN 10-06-2019 AND

Sundeep Kumar Makthala

DATE: 06-07-2019



# Certificate of Internship WE PRESENT THIS CERTIFICATE TO

T YESMANTH

M& I.A MI IN APPRECIATION FOR YOUR SUCCESSFUL WORK AS AN INTERN ON . THE INTERNSHIP WAS CONDUCTED BETWEEN 10-06-2019 AND 06-07-2019

Sundeep Kumar Makthala Chairman, Digithon\*

DATE : 06-07-2019

Frankin Join & Associates Character Abcountants

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Orectall Ms. G. Greeks Reddy, performed her dinker and responsibilities esteriorists of a consents denotes off runes. With her enhancement to week, each and process, I am certers that she would make a great completer to interaction.

We want her all the best in her future endeavor-

For Procendian Associates: Contract Accountants,

Va antiti

Provien Jain Progrador Place Hyderabadi Date 04.07/2019

> Address 2.231071A/5/1 Tick Nagar, Hydataoad T.G. 600044 cmail pravmentan 387genet.com, Tekapasan 040 85911580



Fab City, Plot No. 6, Survey #114/P, Srinagar Village, Maheshwaram Mandal, Rangareddy Dist. - 501359, Telangana, India. Office Tel: + 91 40 67 30 3000

ewSys India Prt. Ltd. Hyderabad Division:

12th July 2019

### To Whomsoever It May Concern

This is to certify that Ms. Hima Bindu underwent her Internship with us at RenewSys Hyderabad during the period from 28<sup>th</sup> May 2019 to 12<sup>th</sup> July 2019 for the Projects Titled 1) Process of Solar Module Manufacturing Upto Pre – Lam EL – Line 3 & Crack Analysis 2) Customer Satisfaction Survey.

During her internship we found her very receptive, intelligent, motivated and hard working.

We wish her all the best in her career.

For Renewsys India Pvt. Ltd.

IVNS Raju General Manager - HR & Admin



RenewSys India Pvt. Ltd. Registered Office: 98, Jolly Maker Chambers No. 2, 225, Nariman Point Mumbai - 400021, Maharashtra, India. CIN: U36990MH20119TC220771 Tel: +91 22 30040500, renewsys@renewsysindia.com, www.renewsysworld.com

Manufacturing plants at Benguluru and Hyderabad



### Internship Experience Certificate

TUKARAM & CO LLP

CHARLER D ACCOUNTANT

DUSING

The esto certify that N Karuna Geetha studying MBA from Chaitanya Bharathi Institute es technology, Hyderabad has successfully completed her internship program of 45 days

Financial Statement and Ratio Analysis and was actively & diligently involved in the protasks assigned to her.

During the span, we found her to be a sincere, intelligent, hardworking and creative states with a very good grasping power. We have always observed her that she is very eager to a end and acquire knowledge. Her learning powers are very good and she picks up rapidly. Quality of her work and evaluation proved that she gives utmost priority to work. Moreover the interpersonal and communication skills are brilliant.

We wish her bright future.

For Tukaram & Co LLP **Chartered** Accountants

P Murali Partner M.No.2216



# TWG INTERNATIONAL Delivering Excellence

### Government Recognised Center Code # 16102 **ISO 9001:2015 CERTIFIED**



# This is to certify that MIS / AIR CHOWDAVARAPU MALAVIKA

Successfully completed the Project / Internship in our company

on Human Resource Policies From 3<sup>rd</sup> June 2019 to 29<sup>th</sup> June 2019

WORLT

TWG







97/16102/GC/20 verify online at www.technoworldgroup.com



CORP OFF : "VISAKA TOWER", 1-8-303/69/3, S.P. ROAD, SECUNDERABAD - 500 003. TEL : +91-40-2781 3833, 2781 3835, FAX : +91-40-2781 3837, 2789 1833, www.visaka.co E-mail : vil@visaka.in

### REF: VIL: ITP: CBIT: HR: 2019

Date: 06-July-2019

To

Dr. Harileela Vemula HOD, School of management studies, Chaitanya Bharathi Institute of Technology, CBIT Campus, Gandipet, Kokapet, Hyderabad, 500075.

Dear Dr. Harileela Vemula,

This is to certify that Ms. M.S.V Sai Divya, from School of management studies, Chaitanya Bharathi Institute of Technology, Hyderabad, has successfully completed her Internship in our corporate office from Dt.03.06.2019 to Dt. 29.06.2019. She has done her internship in "Recruitment process and Importance of job description for recruitment" under supervision and guidance of our Human resources Team. She has shown a great amount of sincerity, interest and dedication in carrying out the responsibilities assigned to her during the internship.

We wish her all success in future.

Yours faithfully, For VISAKA INDUSTRIES-LIMITED B. RAGHAVAIAH President - (Gr. HR & Admin)

Regd. Office & Factory Factory : A.C. Division II Factory : A.C. Division III Factory : A.C. Division IV Factory : A.C. Division VI Factory : A.C. Division VI Factory : A.C. Division VII Factory : A.C. Division VII Factory : Textile Division Factory : V-Boards Division I A.C. Division I, Survey No. 315, Yelumala Village, R.C. Puram Mandal, Sanga Reddy District, T.S. Pin 502 300.
Behind Super Gas, Manikantham Village, Paramathi-Veiur Taluq, Namakkal District, Tamil Nadu, Pin 637 207.
70/3A, 70/3, Sahajpur Industrial Area, Nandur Village, Daund Taluka, Pune District, Maharashtra, Pin 412 020.
Changsole Mouza, Rankibundh, G.P. No. 4, Saliboriblock, Midnapore West, W.E. Pin 721 147.
No. 27/1, G. Nagenahalli Village, Kora Hobli, Tumkur, Karnataka, Pin 572 138.
Vill. Kannawan, PS Bachrawan, Tehsil Maharajgunj, Dist Raebareli, U.P. Pin 229 301.
Survey No. 355, 356, Juljuru (V), Chennaropalem (P), Veerulapadu (M), Near Kanchika Cherla, Krishna Dist, A.P. Pin 521 181 Plot No. 2006, 1994, Khata No. 450, At-Paramanapur Manejwan, Navamunda Viilage Sambalpur Dist, Odisha, Pin 763 200.
Survey No. 179 & 180, Chiruxa Village, Mouda Taluk, Nagpur District, Maharashtra, Pin 441 104.

Division I : Gajalapuram Village, Peddadevalapally Post, Tripuramam Mandal, Near Miryalaguda, Nalgonda Dist, T.S. Pin 508 207.



Date : 09th July, 2019.

### CERTIFICATE

This is to certify that Ms.K.SRAVANTHI, student of Chaitanya Bharathi Institute of Technology (Autonomous), Hyderabad, studying M B A has completed Internship in our organisation on RECRUITMENT & SELECTION PROCESS from 25<sup>th</sup> May, 2019 to 09<sup>th</sup> July, 2019.

During the above period she attended on all the working days and completed the Internship sincerely and dedicatedly.

During the period of Internship her performance and conduct was very good.

We wish her every success in future.

For Ahlada Engineers Limited

Authorised Signatory

da

Ci .

### Ahlada Engineers Limited

Telangana, India, Phone: +91 96655 00511 / 96665 00522, E-mail: engineering animal Mandal, Mercinal Dist, Hyderabed - 569 043.



(Private Detectives, Insurance Investigators & Industrial Security Consultants)



Plot No. 666, Road No. 34, Jubilee Hills, Hyderabad - 500 033. Ph. No.: 040-2354 9655, 2354 2981 E-mail : hyderabad@opdss.com, www.opdss.com

19<sup>th</sup> July,2019

### TO WHOM SO EVER IT MAY CONCERN

This is to certify that Ms.Presingu Yuvasravani D/o. late P.Tulasi Das ,student of MBA in M/s.Chaitanya Bharathi Institute of Technology ,Gandipet ,Hyderabad-500075,Telangana has undergone internership in our Organisation on the following topics from 08<sup>th</sup> April,2019 to 06<sup>th</sup> July,2019.

### In Finance & Accounts Department

- 1. Receivables
- 2. Accounts Payables
- 3. Data Entry
- 4. Invoice Generating
- 5. Petty Cash vouching & verification

This certificate is being issued on her request to submit at her college.

### Thanking you

For Omsai Professional Detective Security Services(P) Ltd,

R Umakanth President-HR & Admin

Mead Office : 57-3-4, Sri Rama Nilayam, Patamata, Vijayawada - 10. Ph. 24763-0, 2-77156. | htto@opdss.com BRANCHES : VISAKHAPATANAM -TIRUPATI-GUNTUR-ONGOLE NELLORE- ELURU-RAJAHWUNDRY-KAIONADA-KURNO-OL-ANANTHAPUR-KHAMMAM-CHENNAI-COIMBATORE-BANGA .ore-BHUBAHESWAR-MUMBAI-JAIPUR-NAGPUR-INDORE.

**建筑的保留** 



To,

Mr. Kodali Abhilash

# Sub: Internship with Tutoroot Technologies Pvt. Ltd.

### Dear Abhilash,

Further to your application & our subsequent discussion; we are pleased to offer you a role as an intern with our organization. The details are as under:

Role: Intern - BDE

Start Date: 27th May 2019

Internship Period: 45days

Responsibilities: You will be given an assignment in Tutoroot Business Development Team.

Stipend: Rs 8,000 per/Month

Please confirm acceptance of this offer in writing.

Wishing you a pleasant experience.

For Tutoroot Technologies Private Limited

Mana Mahall Uma Mahesh Murty

Manager HR



### Tutoroot Technologies Private Limited.

CIN: U80904TG2018PTC126724. Regd.Off : NCC 5uilding, 3rd Floor, Western Wing, Madhapur, Hyderabad-500081. INDIA Ph + (91) 40 23119633 | www.tutoroot.com | E-mail: info@tutoroot.com



July 18th, 2019

### TO WHOM IT MAY CONCERN

This is to certify that Mr. Gautham Jawahar Reddy, successfully completed 45days (from 27<sup>th</sup> May 2019 to 12<sup>th</sup> July 2019) internship at Tutoroot Technologies Pvt Ltd.

His Responsibilities during Internship includes:

- Calling on the leads and scheduling online demo with the students/parents
- Understand customer profile & problems to explain implication of ineffective traditional learning methods
- To guide and counsel students/parents on the advantages of personalized online tutoring
- Prospecting, Counselling, Product Demonstration, Pricing and after Sales Support
- Maintaining healthy relations with all paid students/parents and keeping track of renewal accounts
- Co-ordinate with the operations team to ensure smooth delivery of the scheduled classes
- · Building strong student data base by generating new and referral leads
- Reporting of daily activities status including follow ups, pipeline cases and expected payments

During the period of her internship program with us she had been exposed to different process was found punctual, hardworking and inquisitive.

We wish him all the best in his future endeavours.

For Tutoroot Technologies Pvt Ltd

lina Mal Uma Mahesh Murty Manager - HR



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### To whom so ever it may concern

Titls is to certify that Mr. Mohammint Muschall Hustern S/Q Mr. Khaza Mazhar Hussain student of MBA Boni Charlany a Bharathi Insertife (4) Technology - College has f successfully completed preset work 8 internship program from 28" May 2010 in 50" July 2019 wab (DBI Feneral Hierd to on SMarkeling & Finance: A Study On Present Scenario And Market Potential Of IDBI Federal LIC LTD."

During this period he was involved with all the concepts of Insurance & Emancial Plannie -

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CALLENCE NO

We wish him a bright Future & success ahead

(Authorised Signature)

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From 3rd June 2019 to 29<sup>th</sup> June 2019

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RenewSys India Pvt. Ltd.

12th July 2019

### To Whomsoever It May Concern

This is to certify that Mr. Palaram Sharan underwent his Internship with us at RenewSys Hyderabad during the period from 28<sup>th</sup> May 2019 to 12<sup>th</sup> July 2019 for the Project Titled Analyzing Cell Breakage.

During his internship we found him very receptive, intelligent, motivated and hard working.

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We wish him all the best in his career.

For Renewsys India Pvt. Ltd.

**IVNS** Raju

General Manager - HR & Admin

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### DE GRUYTER

### Bleaching

Madhuri Pydimalla\* and Ramesh Babu Adusumalli

## Unbleached and bleached handsheet characteristics of Subabul heartwood and sapwood

https://doi.org/10.1515/npprj-2019-0055 Received June 24, 2019; accepted February 25, 2020; previously published online April 3, 2020

**Abstract:** The objective of this study was to understand the influence of bleaching on % residual lignin, water retention value, brightness and morphological properties of Subabul heartwood and sapwood pulps. The second aim was to compare the properties of unbleached and bleached handsheets with respect to tensile index and fractography. Screened wood chips of Subabul were subjected to kraft cooking (165 °C, 3 hours) followed by ECF bleaching and refining. When unbleached handsheets were compared, higher tensile index was found for sapwood sheets (29.8 N.m/g) than heartwood sheets (12.8 N.m/g). Therefore, it is recommended to use un-

bleached sapwood sheets for packagPagerad1 ap/lica11 tions. The bleached pulps have exhibited negligible resid

### Introduction

Paper is a nonwoven sheet in which approximately 0.25– 4.5 mm length and 10–50 µm width fibres are bonded to form a three dimensional network. The species widely used for papermaking in India are Eucalyptus and Subabul. A large fraction of bleachable chemical pulp is produced by the kraft process even though lignin remains a major constituent of pulp cell wall even after 3 h of kraft cooking (Reeve 1996, Jafari et al. 2014). Bleaching performed to remove lignin from cell walls gives higher brightness to the paper and thus leads to more durable and stable paper (Levlin 1999). Bleaching increases the crystallinity index because lignin is removed, lumen is

Poreby microfibril orientation in cell walls inoncero et al. 2003). Unbleached pulp contains

high levels of lignin, therefore less selective chemical e.g.,



### Analysis of Characteristics of Launcher Missile System and Its Optimization to Reduce Tip-Off Effect During Launch

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**Abstract.** This paper focuses on analyzing the motion characteristics of the launcher missile system and locations of interactions between missile shoes and launch rail. The deviation of direction of the thrust force from flight axis of the missile is known as thrust misalignment. And the deviation of direction of the missile is known as tipoff rate. The main objective of this paper is to analyze characteristics of launcher missile system and its optimization to reduce tipoff rate. The analysis is performed by modeling and simulating the launcher missile system using CAD package and ADAMS software.

**Keywords:** Missile · Launcher missile system · Thrust misalignment · Tip-off rate

### 1 Introduction

Missile is a self-propelled guided weapon, designed to deliver an explosive warhead at the target with great accuracy at high speed. It moves in the launcher for a certain amount of time during launching phase. Launching device, canister is used for launching of the missile [1].

On application of thrust force, missile attains free flight as it separates from launcher. With front shoe becomes unsupported while the rear shoe still supported by launch rail when missile reaches end of launcher, missile deviates from actual flight path under force of gravity known as known as tipoff rate. Mathematically, the tipoff rate is represented by the angular velocity of the missile with respect to the Z-axis (pitch axis), also known as pitch rate.

From the engineering point of view, minimum tipoff rate is desirable [2]. The purpose of this work is to achieve the minimum tipoff rate by analyzing the motion characteristics of the system and optimizing the obtained result by varying the parameters such as clearance between missile shoe and launch rail, location of the shoe with respect to center of mass of the missile and the number of launch lugs. Cochran, [3]: Developed a physical model of a launcher system in order to study the factors

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### A Comparative Study on Performance of 3D-Printed EDM Electrode with Conventional EDM Electrode



L. Mahipal Reddy, L. Siva Rama Krishna, S. Sharath Kumar and P. Ravinder Reddy

Abstract Electro Discharge Machining (EDM) is an unconventional machining process used to make hard metal tools and complex shapes, which are difficult to machine by the conventional machining process. Additive manufacturing is the process of creating a 3D object from a CAD Model by adding one layer over another layer. In this work, it is proposed to fabricate an EDM electrode using Direct Metal Laser Sintering (DMLS) 3D printing process and compare its performance with conventional EDM electrodes in terms of Material Removal Rate (MRR), Tool Wear Rate (TWR), and surface finish. The material used for printing the EDM electrode is aluminum AlSi10 Mg and it is proposed to print it on the Direct Metal Laser Sintering 3D Printing machine. The workpiece material used for the EDM process is steel alloy 681-08 of grade D3. The experiment is conducted on EDM with the DMLS electrode and conventional electrode by varying the peak Current (I), Pulse on time ( $T_{on}$ ), and Pulse off time ( $T_{off}$ ). A comparison of MRR, TWR, and surface roughness is made varying the above-mentioned parameters.

Keywords EDM · 3D Printing · DMLS · MRR · TWR

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||Volume 9, Issue 4, April 2020||

# **Structural Analysis of Pressurised Canister**

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**ABSTRACT**: In this paper a canister (container) was designed and analyzed which is used for transportation and storage of missile. The canister is made of composite shell structure stiffened with rectangular ribs on the interior surface. An opening is provided on the canister at the rear end to insert the missile. Canister protects the missile from external heat, dust and moisture. Therefore canister plays an important role for missile. It was identified several causes of disturbances which damages the canister such as internal load, stacking load and lifting loads. Efforts have been made to design and optimize the canister for these loads. Detailed finite element stress analysis is carried out to determine the static response of the designed composite missile canister structure under mechanical loads. ANSYS package has been employed to perform the structural analysis.

KEYWORDS: Canister shell, Stress Analysis, Stacking Loads, Lifting Loads, Stability.

### I. INTRODUCTION

A missile is an object which is forcibly propelled at a target, either by hand or any form of a mechanical weapon. Missile is a weapon that is self-propelled after leaving the launched device, usually with the intent of striking some distant object. Missile is a weapon designed to deliver an explosive warhead with great accuracy at high speed. Missiles are sturdy, well-constructed machines. But, because of their size, weight, and bulk, they are not that easy to handle. Most of the missile damage is unfortunately a result of carelessness and poor handling practices. Therefore we use containers, canisters, and handling equipment for maximum missile safety with minimum handling by personnel.

Dorothy S. Ng [1], has written in a book "Structural Analysis of Storage Container", performed the structural analysis to evaluate the storage container against a rare, short duration event. An accidental free drop of a container may occur in a combination of two events: a rare, short duration earthquake concurrent with an operation of raising the storage rack to a maximum height that the crane is capable of. This hypothetical free drop may occur only to the container in the uppermost shelf of the storage rack. The analyses were the structural evaluation of the storage container to determine the material containment integrity of the storage container after the accident. The evaluation was performed simulating a free drop from the storage rack, with a maximum load in the container, striking an unyielding surface in the worst orientation. The analyses revealed that, in the very unlikely event of a container drop, the integrity of the hermetic seal of the storage container could be compromised due to plastic deformation of the lid and mating flange. Simple engineering and administrative controls can prevent that from occurring. Serena, Joseph M [2] had presented a paper on "An On-Site Demilitarization Container for Unexploded Ordnance" and explained about design development, fabrication and analysis of the container. And also presented design techniques. At many of these sites, ordnance has been discovered very close to schools, homes, and other inhabited and privately owned facilities. The removal of ordnance presents some hazards from the effects of an explosion, including blast overpressures and fragment projectiles. Both people and their property must be protected from these effects. Currently, all munitions must be buried before onsite detonation, or transported to a remote site for demolition. Huntsville center has developed a containment structure for use in on-site demolition of unexploded ordnance. This structure is designed to contain the effects of the explosion and limit evacuation to a very small work area. The container uses innovative materials for the containment of fragments and reduction of overpressures. The container will permit onsite detonation of ordnance much more safely and efficiently. Bob Matthews [3] suggested book "Applied Stress Analysis" and explained the importance of the fiber orientation. He had studied on unidirectional tape as well as woven fabric, which have a significance of better surface finish, higher allowable strength and stiffness, lower raw material cost for unidirectional tape and for woven fabric low fabrication costs, easier forming on contours and corners and also more resistant to surface breakout and delamination. From these studies he concluded that the fiber should be arranged to optimize resistance to loads, limit number of different angles to expedite manufacturing and for filament winding hoop plies are used. The orientation of the tailor fiber arrangement explained as +/- 45 degree plies give buckling stability and carry shear, 0 degree plies give column

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# EXPERIMENTAL STUDIES ON LAUNCH DYNAMICS OF SLANT LAUNCHED SURFACE TO AIR FLIGHT VEHICLE

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### ABSTRACT

Surface to air flight vehicles are launched at low slant angles to intercept and neutralize low flying attacking enemy aerial targets like fighter aircrafts, helicopters which are on cruise missions. These flight vehicles are generally housed in hollow launch canisters which are used for storage, transportation and launching through mobile launchers. The lateral signature of launch canister is chosen such a way that more number of canisters can be accommodated per one launcher. To accommodate the flight vehicle in launch canister, it is accordingly configured with foldable wings and fins. New designs of flight vehicle, canister and launcher system need to be verified for all the interfaces and the controllability of flight vehicle when it clears the canister. While coming out of canister at low elevation launch angles, the flight vehicle starts deviating from its intended trajectory due to the combination of gravitational force, thrust misalignments, aerodynamic forces, low initial thrust, lateral shift of centre of mass, deployment forces of wing and fin etc. To record actual launch dispersions and to remove any hidden uncertainties in new designs, a live firing with a full scale short duration flight vehicle was undertaken. A propulsion system was specifically designed to function for a small duration simulating the actual thrust time profile of that of the full scale rocket motor system for that initial duration. One short duration rocket motor system was static tested to verify the design parameters and another one was integrated with the rest of the actual flight hardware
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### Comparative analysis of the orientation dependent tensile deformation of commercially pure titanium and titanium alloy OT 4-1

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#### ARTICLE INFO

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Keywords: Commercially pure titanium (CP-Ti) Microstructure Mechanical properties Tensile deformation Titanium alloy OT 4-1

#### ABSTRACT

Correlation of mechanical properties and tensile deformation of hexagonal commercially pure titanium (CP-Ti) and acicular alpha titanium alloy OT 4-1 was studied in the present investigation. Tensile specimens were prepared along the rolling direction, along 45<sup>0</sup> to the rolling direction and transverse to the rolling direction to obtain different tensile deformation from cold rolled annealed sheets of CP-Ti and titanium alloy OT 4-1. The conjoint control of essential microstructural features and the orientation of specimen on tensile properties of commercially pure titanium and the titanium alloy OT 4-1 was highlighted. © 2020 Elsevier Ltd. All rights reserved.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

#### 1. Introduction

Commercially pure titanium has wide applications in a variety of areas such as marine, chemical, plate-type heat exchangers, pressed parts and they are highly formable. OT 4-1 is a titanium alloy used for high-temperature applications in the aerospace industry [1] i.e. airframes, these materials are used extensively in the automotive sector. These materials also utilized for chemical processing industries, textile and paper plants, medicine, marine, oil industry, and even in some sports components [3]. Titanium experiences allotropic transformations from  $\alpha$  to  $\beta$  at 882.5 °C if  $\beta$ stabilizers such as Mo, V, W, Nb, and Ta are present in the crystallographic structure [5]. If the above said  $\beta$  stabilizers are present in the material they should exhibit the response to heat treatment and  $\alpha$  stabilizers like Al, O, and N are present in the material they don't depend on heat treatment.

The present investigation makes attempts to correlate the uniaxial tensile deformation of CP-Ti and OT 4-1 including the correlation of microstructure. Three initial orientations are deformed in uniaxial tension and the evaluation is compared between two materials.

#### 2. Experimental setup

#### 2.1. Sample preparation

The samples were prepared by an electrical discharge machine (EDM) which can be used efficiently in machining high-strength and temperature-resistant material like titanium alloy OT 4-1 and commercially pure titanium as shown in Fig. 1. Alternatively, machining can be done by all conventional methods but after the machining, the properties of the material may certainly differ. So EDM was best suited for sample preparation to protect the inherent properties of the above said two different materials [2].

The workpiece substance for titanium alloy OT 4-1 has the following composition: 2.24% Al, 1.44% Mn, 0.001% C, 0.048% V and rest Ti [12]. For the Commercially Pure Titanium (CP-Ti) the composition 0.094% O, 0.018% N, 0.0032% H, and balance Ti [3].

The microstructural studies of both the materials were studied before going to mechanical testing. After metallographic specimen preparation, with the help of an optical microscope, the sample was observed and the microstructure of CP-Ti material was revealed and it has  $\alpha$  phase containing crystals of the hexagonal close-packed structure as shown in Fig. 2 [11].

Commercially pure titanium considered as  $\alpha$  titanium alloy [4], as  $\alpha$  indicates the phase present in the material and hexagonal

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# Parametric Optimization During Wire EDM Taper Cutting on AISI D2 Steel Using Desirability Function

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Abstract. Wire electrical discharge machining (WEDM) has become very popular non-traditional process of machining. Taper cut WEDM involves making surfaces of sloping, this is essential in machining tools with angles included. AISI D2 steel with Mo and Cr has a variety of applications in engineering. This paper aims to study the effect of taper angle, wire feed and wire tension on the responses such as cutting time, angular error and surface roughness and also find the optimum values of each variable that achieve optimum cutting conditions. Central Composite design (CCD) of response surface methodology was used to design the experiments and five values of each of the three variables are taken. In order to combine the responses and the parameters in one model regression model has been generated. For each response separate analysis of variance (ANOVA) was calculated and the optimization was performed using desirability function. Results show that the most significant parameter is taper angle and the optimized parameter levels of the machining are taper angle 6°, wire feed 5.624 mm/min and wire tension 7.886 g respectively.

**Keywords:** Taper angle  $\cdot$  Wire feed  $\cdot$  Wire tension  $\cdot$  Angular error  $\cdot$  Response surface methodology

#### 1 Introduction

Wire electrical discharge machining is a non-traditional process of machining uses heat from electrical sparks emitted from a wire of limited diameter to generate craters in the work piece while submerged in dielectric fluid. Taper WEDM aiming at producing segments with surfaces of sloping by offsetting the upper from lower guides of the wire holders where the angle is produced. Depending on the mechanical properties of the wire and the work piece thickness the ultimate angle value can be determined. Angles of  $(\pm 30^\circ)$  can be made in a work piece of 400 mm thickness but wire breakage is going to take place due to more vibrations [1, 2] and the higher the thickness to be cut, the lesser the angle that should be set.

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# Prediction and Comparison of the Dilution and Heat Affected Zone in Submerged Arc Welding (SAW) of Low Carbon Alloy Steel Joints

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#### ABSTRACT

The present investigation has been made to realize the effect of submerged arc welding (SAW) process parameters in 'Purging' condition and has been compared to the traditional 'as weld' condition. It uses open-circuit-voltage (OCV), wire-feed-rate (WFR), welding-speed (WS) and nozzle-to-plate distance (NPD) as process parameters. The design of experiments is utilized to carryout efficient experimentation and multiple regression analysis is to build mathematical models to foresee responses like dilution and heat affected zone. The performance evaluation of control levels, which has been shown through the S/N ratio, its significance, along contributions is computed via ANOVA. The models are developed to build correlation among the parameters. The Grey Relational Analysis (GRA) is to normalize and optimize the results. These developed models are adequate; GRA responses are agreeable and are found to be within limits through confirmation tests. Results indicate that the best combination for Heat Affected Zone (HAZ) minimization is lower level of OCV and higher levels of WFR, WS and NPD; High dilution, in percentage, in both welding conditions. The Purging condition values are shown better than the as-weld condition values.

Keywords: Submerged Arc Welding; Design of Experiments; Multiple Regression Analysis;

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# EXPERIMENTAL INVESTIGATIONS ON SEMI-ADIABATIC DIESEL ENGINE WITH EXHAUST GAS RECIRCULATION FUELLED WITH TAMARIND BOIDIESEL

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#### ABSTRACT

Particulate emissions and nitrogen oxide  $(NO_x)$  levels are exhaust emissions from compression ignition (CI) engine. Once they are inhaled-in, they cause health hazards, besides environmental impact. Hence control of these emissions are important and an urgent task. In the context of depletion of fossil fuels, ever increase of fuel prices in International Market causing economic burden on developing countries and increase of pollution levels with fossil fuels the search for alternative fuels has become pertinent. Vegetable oils have high viscosity and low volatility causing combustion problems in diesel engine. Biodiesel produced from feedstock by the process of esterification are renewable in nature, biodegradable, provide energy security besides addressing environmental concerns. However, drawbacks of high viscosity, low volatility call for low heat rejection (LHR) or Semi Adiabatic diesel engine (SAD e).

Investigations are carried out to evaluate the performance with different operating conditions (normal temperature and preheated temperature) of tamarind biodiesel with low heat rejection diesel engine consisting of air gap insulated piston with stainless steel, a low thermal conductivity material and air gap insulated liner with stainless steel insert with varied injection timing and injection pressure with provision of exhaust gas recirculation (EGR) with Tamarind biodiesel with diethyl ether as additive.

**Key words:** Particulate Emissions, Nitrogen Oxides (<sub>NOx</sub>), LHR engine or Semi Adiabatic engine, Exhaust Gas Recirculation (EGR), Stainless Steel. (SS).

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## Development and evaluation of water absorption, compression and impact properties of okra Nanofibrillated cellulose reinforcement in epoxy resin composites

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#### ARTICLE INFO

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Keywords: Okra Nanofibrillated cellulose Epoxy resin Nanocomposites Water absorption Compression and impact propertites

#### ABSTRACT

Nanofibrillated cellulose were extracted from natural fibre of Okra plant by a chemical, Acid hydrolysis and mechanical method to study their potential for use as reinforcement fibrils in bio composite applications. The okra Nanofibrillated cellulose composites were prepared by Compression moulding and VARTM method. The Present work was to investigate water absorption, compression and impact properties of okra Nanofibrillated cellulose reinforced epoxy composites. The water absorption compression and impact of okra Nanofibers Reinforced Epoxy composites were studied and the effects of okra Nanofiber (0, 1, 2, 4 and 6 wt%) are also examined. The water absorption, compression and impact properties of Nanofibre reinforcement has improved when compared with the virgin composite. Water Absorption capacity is less for okra Nanofibrillated cellulose reinforced epoxy resin composites sample when compared to other composite samples but it is high when compared to pure epoxy resin sample. The compression strength of 4 wt% okra Nanofibrillated cellulose composites shows improve quality result among other composites and it gives 4 wt% improved strength of the pure epoxy resin composites. Whereas 4 wt% okra Nanofibrillated cellulose composites (OKCNFs) shows improve impact strength as compared to Epoxy resin composites. The okra Nanofibrillated cellulose composites are tested by means water absorption, compression and impact test based on ASTM standard. Effect of Fibril surface Treatment on water absorption, compression and impact properties are also observed. © 2019 Elsevier Ltd. All rights reserved.

Selection and peer-review under responsibility of the scientific committee of the 1st International Conference on Manufacturing, Material Science and Engineering.

#### 1. Introduction

Development of thermosetting natural fibrillated cellulose composites has drawn attention of the researchers all over the globe, owing to the availability and biodegradability of natural fibers [1]. Such materials are used for making variety of components for domestic, automobile, structural and packaging applications. In recent times, Nanofibrillated cellulose composites have been the hot research area for automotive, packaging and medical applications [2–10]. Nanofibrillated cellulose composites are fully biodegradable and biocompatible with excellent mechanical properties. Due to high crystallinity and high aspect ratio and

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low density of the nano cellulose fibrils, there is considerable increase in the stiffness of the composites produced. Nano scale cellulose fibrils are produced by a mechanical process called homogenization which involves high energy consumption. In order to lower the energy consumption, the homogenization process is preceded by mechanical treatments such as refining, cryocrushing, biological treatments like enzyme and chemical treatments like alkaline to reduce the size of the fibers before homogenization [2].research interest of using natural fibrils to reinforce polymers is re-emerging in the field of composites manufacturing over the last ten decades [19-23]. Cellulose is the primary constituent of the plant cell wall and can be extracted from a variety of sources, such as bast fibers, seed fibers, grasses, marine animals, invertebrates, and bacteria [13-15]. Besides cellulose, the plant cell wall. Nanocomposites are generally advanced materials where at least the length of one filler is in the order of one nanometer.

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**RESEARCH ARTICLE - MECHANICAL ENGINEERING** 



# Selective Laser Melting of Single Track on Ti–6Al–4V Powder: Experimentation and Finite Element Analysis

Manowar Hussain<sup>1</sup> · Pranshul Gupta<sup>2</sup> · P. Kumar<sup>4</sup> · A. K. Das<sup>3</sup>

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#### Abstract

The present work has been carried out to establish finite element analysis (FEA) simulation of selective laser melting (SLM) process and validate through experimental results obtained on the powder bed of Ti6Al4V alloy. Process parameters included variable laser power (60–75 W) and scan speed (200–400 mm/min) along with constant parameter and the laser spot diameter of 0.45 mm. Variation in width and depth of melted track was observed through an optical microscope and was compared with FEA results. A code for a nonlinear transient model was developed in ANSYS parametric design language to simulate the process of SLM. It was observed that both the width and depth of the melt pool decrease at high scan speeds and both dimensions increase with power increase. The FEA code developed shows an average deviation of 4.5% in width and 4.65% in depth from the experimental results. The FEA model can be used to establish parameters to obtain specific dimensions of the melt pool in single line scan and optimize the process of SLM by controlling the width and depth of the melt pool.

Keywords Laser · Finite element analysis · SLM · DMLS · Beam spot diameter

#### 1 Introduction

Advancement in rapid prototyping has resulted in numerous methodologies for manufacturing in small scales and in development stages of the product. Direct metal laser sintering (DMLS) is often used interchangeably with selective laser melting (SLM) for the process of layer manufacturing using metal powder fused using a high-speed laser. Ti6Al4V is known for its superior mechanical characteristics, namely hardness, wear and chemical resistance and high strength to weight ratio. It has found high utilization in turbine engines and airframe applications due to its good diffusion-bonding and superplastic forming characteristics. Due to its low modulus, good fatigue and tensile strength and biological compatibility, it is used for bone screws, elbow,

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hip, knee and other replacement joints. Ti–6Al–4V is also used in high-performance cars, for manufacturing reciprocating and rotating parts [1]. This process enables manufacturing of more complex designs with properties similar to that of bulk material. SLS results in porosity which is undesirable for tools and dies. For this reason, selective laser melting (SLM) has been proposed in which powder particles completely melt to form solid of about 95% density of the metal.

The literature study on simulation of SLS and SLM process reveals that a lot of work has been done on these processes, including both single and multiple layers in 2D and 3D. Most of the work has been concentrated on the study of stress-strain and temperature distribution. Matsumoto et al. [2] developed a single-layer selective laser melting (SLM) FEA model for the study of temperature and stress developed within the solidified layer on the powder bed. It was also found that the stress and the deflection caused while the laser travels on the track depend on the temperature and the length of the track. As the length of the track is increased, the extent of the deflection associated with the solid part gets increased. Due to this reason the scanning of a long track is avoided to fabricate a large area on the powder bed. Yadroitsev et al. [3] discussed the geometry of a single track over a substrate for various materials and concluded on the versatile nature of the parameters and deviation from them,



# A Study on Welding of Thin Sheet of Ti6-Al-4V Alloy Using Fiber Laser and Its Characterization



Manowar Hussain, Gulshad Nawaz Ahmad and Pankaj Kumar

Abstract In the present research work, an attempt has been made to study and investigate the weldability of 1.2-mm-thick Ti6-Al-4V alloy sheet using CW (continuous wave) fiber laser. The influences of the variable process parameters such as laser power, weld scanning speed and laser beam diameter on the microstructure, heat-affected zone (HAZ) and mechanical properties of the final butt-welded joints of Ti6-Al-4V sheets have been investigated. All the experiments were performed by using a CW fiber laser having a laser power capacity of 400 W. At different parameter setting conditions such as laser power varying from 200 to 350 W, weld scanning speed from 120 to 200 mm/min and laser beam diameter (0.4 mm) were considered for the experimentation. Based on the experiments weld quality was investigated and characterized in terms of the surface microstructure, micro-hardness, and tensile strength of the welded samples. Morphological studies at different processing conditions were carried out to study their effects on the HAZ (Heat-affected zone) and weld bead geometry. Microscopic images of welded samples clearly show a decrease in weld width of the welded sample with an increase in weld scanning speed and with increasing laser power increase in width was observed. At a scanning speed of 120 mm/min with varying power from 200 to 350 W the size of heat-affected zone (HAZ) are 3.55, 3.70, 3.84, 4.8 mm, and the corresponding size of fusion zones is 1.751 mm, 1.83 mm, 1.921 mm, 2.032 mm, respectively. The trend in micro-hardness variation was observed and it depends on grain size in laser welding. At 350 W laser power with varying speed from 120 to 300 mm/min, the micro-hardness values of the welded sample were found as 387.1, 395, and 403 HV. The tensile strength of the

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# Optimization of Micro-electro Discharge Drilling Parameters of Ti6Al4V Using Response Surface Methodology and Genetic Algorithm



#### Pankaj Kumar and Manowar Hussain

Abstract In the present investigation, an organized study with optimization of the process parameters for the fabrication of micro-holes and their surface integrity is carried out using the response surface methodology (RSM). The influence of variable parameters, such as machining voltage and machining on time, on the recast material layer and micro-hardness of the machined sample were investigated. The RSM is used to establishe a regression equation to predict output parameters such as microhardness and thickness of recast materials of the fabricated holes. From the developed model, the effects of the input variable parameters on the micro-hardness, thickness of recast materials and change in the chemical composition are accomplished with the optimized results. In order to get minimum values of recast layer thickness and microhardness of the fabricated micro-holes, a mathematical model was established using response surface methodology (RSM), and subsequently, genetic algorithm (GA) was utilized to reach a set of input machining parameters. Machining input parameters such as gap voltage (V) and machining on time  $(T_{on})$  were selected. The analysis of variance (ANOVA) result indicates that developed models are adequate. The genetic algorithm method in conjugation with RSM is able to identify a particular set of machining parameters which gives minimum values of recast layer thickness and micro-hardness. Confirmation test is also carried out and found that the difference between predicted and measured value is insignificant.

Keywords Mirco-EDM · Recast layer thickness · Micro-hardness · RSM · GA

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# Effects of Micro-EDM Parameters on the Surface Integrity of the Micro-Holes Fabricated on Nickel Sheet



#### Pankaj Kumar and Manowar Hussain

Abstract This paper presents the machining of the nickel sheet using The micro-EDM process. The effect of machining parameters such as pulse on time and gap voltage on the surface integrity parameters such as recast layer thickness, heat affected zone, change in micro-hardness of the workpiece surface and metallurgical transformation in the machined samples has been reported. It is found that ultrasonic vibration given to the workpiece, results in a reduction in the thickness of the recast layer and varies from 7 to 22  $\mu$ m. The hardness of the fabricated micro-holes improves significantly on the introduction of ultrasonic vibration to the workpiece and was in the range of 116–141HV. In this study, heat-affected zone was not observed in optical as well as in SEM images. The result of the EDS analysis shows that less amount of the residuals of the carbon and oxygen were present over the fabricated holes.

**Keywords** Micro-hole • Micro-EDM • Nickel sheet • Ultrasonic vibration • Surface topography • Micro-hardness

#### **1** Introduction

In recent years, the needs for the development of products containing micron-size features are growing very rapidly. Some of the application areas of these products include missiles, space vehicles, micro-electromechanical systems (MEMS) and communication systems. The micro-holes are used in various components for different applications such as in fuel injection nozzles, inkjet printer nozzles, spinner holes, drug delivery orifices, and cooling channels of the turbine blades [1]. At present, the micro-holes in different materials are manufactured by different machining processes

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# Ffect of recycled aggregate on shear behavior of steel fiber reinforced self compacting concrete

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#### Abstract

Self-Compacting Concrete (SCC) is flowable and highly viscous which does not require any

# DRIVING CYCLE ESTIMATION AND VALIDATION FOR LUDHIANA CITY, INDIA

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Abstract: Traffic behavior of a city or any area can represent using driving cycle. In India, driving cycles were developed to test Indian vehicle emission standards but not considering higher speed and acceleration of vehicles. The assumption was all vehicle activities to be similar and considered traffic as homogeneous. But in India, traffic was heterogeneous each vehicle activity is different. In this study, the driving cycle was developed for estimating vehicular emissions and fuel consumption. Driving cycle is developed using five parameters namely percentage of acceleration, deceleration, idle, cruise and average speed of vehicles. Micro-trips were used to develop a driving cycle and these micro-trips are extracted from real-world data. K-means clustering method was used to cluster the micro-trips. The microtrips which are nearest to the cluster centre represented as representative micro trips. These representative micro-trips are used for the development of the driving cycle. The driving cycles were developed and compared route and mode wise. The developed driving cycle was compared with Delhi driving cycle. It was observed that acceleration, deceleration rates were high compared to Delhi driving cycle. This methodology can be useful for heterogeneous traffic condition. The developed driving cycles can be easily identified the driving characteristics and vehicle emissions when testing on chassis dynamometers.

Keywords: fuel consumption, emission, micro trips, cruise, idle.

#### 1. Introduction

The main sources of air pollution are vehicular emissions, industrial emissions, dust and storm, emissions from air craft and jets. Vehicular emissions are the main sources of atmospheric pollution in cities. Many cities are facing problems like traffic congestion, vehicular emission because of increase in vehicular population. According to national environmental engineering research institute, 60-70% of air pollution is caused because of vehicular emissions in all major cities. The factors mainly affecting the vehicular emissions are road characteristics and vehicular characteristics. Vehicular emissions are depending mainly on type of engine, age of vehicle, type of fuel and driving cycle. Automotive Research Association of India (ARAI) developed Indian driving cycle (IDC) based on assumption that traffic is homogeneous but actually which is heterogeneous. In IDC, average speed and acceleration considered as 42 km/h

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and  $0.65 \text{ m/s}^2$ , but in many cities, the speed inside city is limited greater than 42 km/h. Generally, the driving pattern is varies from city to city and region to region. The driving cycles developed in certain region may not be suitable to other regions. Generally, driving cycle was defined as "speed-time profile for a vehicle driving under a specified condition for a given city or region". Fuel consumption and vehicular emissions are measured using driving cycles for a particular area.

Driving cycles were divided into two types: transient and polygonal driving cycles. Transient driving cycles were developed based on the on road driving data (Melbourne peak cycle and US FTP cycles). Transient driving cycles were developed to urban or rural areas based on specific driving characteristics. These characteristics differ from one area to another and also differ in same city. The polygonal driving cycles were developed by compose of a sequence of steady state modes like constant acceleration and speed driving modes (Japanese and ECE cycles). These cycles do not explain the real driving behavior due to the effect of vehicle modal operations.

According to their uses, driving cycles were classified into two types: legislative driving cycles and non legislative cycles (Tong *et al.*, 1999). In legislative driving cycles, the driving conditions within their respective boundaries were considered and these cycles were delivered to government for vehicle emission controls. Non legislative cycles were developed for the estimation of fuel consumption and vehicle emissions.

According to the qualitative descriptions driving cycles were divided into three categories: urban driving cycles, sub urban/ composite driving cycles and highway driving cycle. Urban driving cycles have lower average speed and higher acceleration rates. It was observed that, regular stop and go operations in urban areas with heavy traffic flows and many intersections. Composite driving cycles have slightly higher average speed than urban driving cycles but smaller acceleration rates. Highway driving cycles have higher average speed but smaller acceleration rates. It shows that, very less traffic flows and limited stops and minimum number of intersections.

In this study, transient driving cycle was used. This study explains the development of transient driving cycle using five parameters like percentage of acceleration, deceleration, idle, cruise and average speed of vehicles for heterogeneous traffic condition.

#### 2. Literature Review

Kent et al. (1978) developed a driving cycle for Sydney to estimate exhaust emissions. Average speed, root mean square acceleration and percentage idle time were used for driving cycle development. Hung et al. (2005) developed a model to analyze the driving characteristics by using three step approach. In the first step, 10 driving parameters were selected and used in the model. In second step, speed acceleration probability matrix (SAPM) was derived to know the distributions of speed and acceleration. In the third step, driving cycles were developed using 10 driving parameters and SAPM. Hung et al. (2007) presented a methodology to develop a driving cycle to estimate the vehicle emissions. Speed data was collected using on board and chase car technique. For the construction of driving cycle, a lot of parameters were selected. The

developed driving cycle estimation model was validated using performance value and speed acceleration probability distribution (SAPD).

Nutramon and Supachart (2009) and Tamsanya et al. (2009) developed a new method for construction of a driving cycle for Bangkok. Data was collected on few routes and these routes selected that the traffic on these routes represent the traffic conditions on entire Bangkok traffic. Various driving parameters were used in driving cycle construction and these parameters derived from actual traffic data. The driving cycle was constructed by connecting series of several real world micro trips obtained from real traffic data. Kamble *et al.* (2009) develop an urban driving cycle for estimating vehicular emissions and fuel consumption. Five parameters were considered to develop a driving cycle namely percentage of acceleration, deceleration, idle, cruise and average speed. The driving cycle was constructed by connecting series of several real world micro trips obtained from real traffic data. Saleh et al. (2009) developed an urban and rural driving cycle for Hong Kong for cars. 12 parameters were selected for constructing driving cycle for cars. The representative driving cycle was selected by calculating the absolute sums of the relative error (S<sub>i</sub>). The driving cycle with minimum relative error is the representative driving cycle. Saleh et al. (2010) developed a driving cycle for Edinburgh and Delhi using same methodology.

Tong and Hung (2010) proposed a framework on development of driving cycle based on 101 transient driving cycles. In 101 driving cycles, Asian driving was the slowest one and European driving is the fastest and smoothest. Traffic activity patterns should be considered to determining the test routes. Speed data collection methods namely onboard measurement, chase car techniques or their hybrid were explained. Most of the researchers ignored the tendency of zero change in acceleration while constructing driving cycle. Application of succession probability was explained at second-bysecond level.

In this study, driving cycle was developed for heterogeneous traffic condition using five parameters. The next sections describe the methodology and in the subsequent section generation of micro-trips were discussed.

### 3. Methodology

A methodology was proposed for developing a real world driving cycle using micro trips and these micro trips represents the existing traffic conditions. The parameters were used to develop driving cycles are percentage of acceleration, percentage of deceleration, percentage of idle, percentage cruise and average speed. The methodology consists of driving data collection, micro-trips generation, data analysis and driving cycle construction.

#### 3.1 Driving Data

Ludhiana city, in India was selected for this study. Ludhiana city is an important urban center in Punjab and a rapidly growing metropolis of the country. The selected routes and distances are tabulated in Table 1. On-board measurement technique was used to collect the speed-time data. This technique was used for large scale studies and data was collected directly and more accurately. Trimble GPS instrument was used for data collection. The instrument having high sensitivity GPS receiver with a field computer powered by the windows mobile version 6.1 operating system. The final data collection schedule was tabulated in Table 2. There are 2 out of 7 days as weekends that gives the almost 28% of the total week. So this supports way of dividing it into three trips from weekends and 6 trips from weekdays.

Distance (km)

10.3

8.0

6.4

4.5

31

#### Table 1

S. No

1

2

3

4

Total

Selected Routes Represent Real Traffic Conditions

То

Dhandhari

Thakkarwal

Bhai bala chowk

Gill bypass road

#### Table 2

From

Jalandhar bypass

Samarla chowk

Gill chowk

Bhai bala chowk

Devetyme		Total		
Daytype	Morning peak	Afternoon peak	<b>Evening peak</b>	Total
Weekdays	2	2	2	6
Weekends	1	1	1	3
Total	3	3	3	9

#### 3.2. Generation of Micro-Trips

The speed-time profile is divided into smaller units called as micro-trips for driving cycle development. Micro trip is defined as "trip between two consecutive time points at which vehicle is stopped". In previous studies, micro-trips were developed by manual count. In this study, micro trips were developed using MATLAB. Each micro-trip includes five parameters like percentage acceleration, percentage deceleration, and percentage cruise, percentage idle and average speed which were used for driving cycle development.

#### 3.3. Data Analysis

Data analysis was done in two parts. In the first part, base data was analyzed and micro-trips were constructed. Base data analysis involves the development of speed-acceleration frequency matrix and normalized speed-acceleration matrix. The frequency of occurrence of acceleration, deceleration, cruise and idle corresponding to a speed values represented in a matrix form is called speed-acceleration frequency matrix. Normalized speed acceleration matrix was obtained by dividing each cell by total time and divide by 100. Micro-trips were constructed using computer program. In the second part, micro-trips were clustered using K-means clustering algorithm.

The speed-acceleration frequency matrix (SAFD) of three- wheeler on GT road was shown in Fig. 1. The normalized speed-acceleration matrix from the base data (SAPD) was shown in Fig. 2. The sample micro trip for three-wheeler was shown in Fig. 3.

krengels	5-10	210	- 9	100	- 27.4					1000	1000		1000			1000	5		100		100	10	210	totel
9	574	18	34	58	30	30	58	46	50	-50	54	413	70	54	58	34	38	40	16	18	20	18	210	1000
510	294	18	24	18	16	20	30	52	48	12	16	.32	22	22	24	24	30	26	26	12	18	20	340	1122
10.0015	390	26	30	30	10	30	30	84	28	16	28	20	54	10	4	14	18	8	12	26	8	14	378	11.9%
150.29	476	62	58	56	36	36	54	32	24	22	24	32	26	22	40	26	28	26	20	48	42	28	518	32236
10 245	470	52	74	44	34	60	40	56	26	16	32	40	18	14	34	32	28	-44	26	38	58	50	714	2066
2530	556	62	72	82	84	70	56	62	52	22	50	60	32	38	48	48	48	40	38	76	82	86	764	25.28
3035	556	138	138	122	78	92	-48	50	50	36	40	58	56	20	100	104	92	116	96	142	170	172	720	1000031621
32-10	364	106	114	76	72	74	60	56	85	62	120	110	160	94	166	172	178	160	130	176	172	152	324	53.14
40.45	32	30	18	20	20	36	22	30	72	46	102	126	140	96	98	82	90	70	34	38	28	24	52	1306
45.50	0	0	0	D	0	2	0	0	0	0	0	0	0	0	2	0	2	0	0	Ð	0	0	0	
50,55	0	0	0	D	o	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55.60	0	0	Ó	0	0	0	0	0	0	0	0	0	0	. 0	0	0	0	0	0	0	0	0	0	0
60 on war	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	ø	0	0
total	3512	512	562	485	380	450	396	398	444	282	466	899	558	370	574	536	552	590	390	\$72	598	562	4020	18057
	12																							
	dec		7888																					
	idle		413																					
	cruise		486																					

#### Fig. 1.

The Speed–Acceleration Frequency Matrix (SAFD) from Base Data for 3W (Sample)

1.000	10	1.0	S.	Concession in the	100			Surger,			No.		10000	1.1.1	1000	and the	10.00	STREET.			A state of the		516333	11174
1000	2.0645	0.1004	0.1786	0.2009	0.1674	0.1674	0.301	0.2567	0.3013	0.2675	0.3013	1.7186	0.391	0.279	0.312	0.1786	0.19	0.212	0.009	0.067	0.0781	0.009	1.149	9.06
	1.6293	0.1004	0.1339	0.1004	0.0093	0.1116	0.167	0,1786	0.2672	0.067	0.0093	0.1796	0.123	0.123	0,134	0.1339	0.167	0.1451	0.145	0.067	0.1004	0.112	1.875	6.23
1.5	2.1873	0 1451	0.1597	0,1674	0.0558	0,1756	0.179	0 1786	0 1562	0.0593	0.1562	0 1116	0.201	0.056	0.022	0.0781	0.1	0.0415	0.067	0.145	0.0646	0.072	2.154	6.7
1.1	2.656	0.3459	0.3236	0.3125	0.2009	0.2009	0.301	0.1755	0 1339	0 1225	0.1339	0.1756	0.145	0.123	0.225	0.1451	0.156	0.1451	0.112	0.268	0.2343	0.156	2.09	9.68
100	2.6225	0.2901	0.4129	0.2455	0.1597	0.3345	0.223	0.3125	0 1451	0.0093	0.1756	0.2232	0.1	0.075	0.19	0,1766	0.156	0.2455	0.145	0.212	0.3236	0.279	3.964	11.1
200	3.1023	0.5459	0.4017	0.4575	0.4607	0.3906	0.312	0.3459	0.2901	0.1225	0.279	0.5540	0.179	0.212	0.265	0.2675	0.265	0.2252	0.212	0.424	0.4575	0.45	4,205	14.1
500	5.1025	0.77	0.77	0.6807	0.4352	0.5135	0.255	0.279	0.279	0.2009	0.2252	0.5256	0.512	0.112	0.558	0.5805	0.513	0.6472	0.536	0.792	0.9496	0.96	1.017	17.8
200	2.031	0.5915	0.6361	0.4241	0.4017	0.4129	0.335	0.3125	0.491	0.3459	0.6696	0.6584	0.895	0.524	0.926	0.9597	0.993	0.8925	0.725	0.982	0.9597	0.648	1.805	17.8
1	0.1766	0.1674	0.1004	0.1116	0 1115	0.2009	0.123	0.1674	0.4017	0.2567	0.5691	0.703	0.761	0.536	0.547	0.4575	0.502	0.1905	0 19	0.212	0.1562	0.134	0.29	7,28
	0	0	0	0	0	0.0112	0	0	0	0	0	0	0	0	0.011	0	0.011	0	0	9	0	0	0	0.03
200	0	0	0	0	0	. 0	Ð	0	0	0	Ð	0	0	Ð	0	0	0	0	0	0	0	0	0	
300	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.1	0	0	0	0	0	0	0	0	0	0	0	G	0	0	0	0	0	0	0	Ô	0	ø	0	
	19.574	2.0568	3.147	2,7006	2.1203	2.522	2.21	2.2095	2.4652	1.5623	1.6002	4,4303	3.125	2.042	3.192	1.9796	3.051	2.9461	2.221	3.169	3.3032	3.136	22.43	1



#### Fig. 2.

The Normalized Speed–Acceleration Matrix (SAPD) from the Base Data for 3W (Sample)



**Fig. 3.** *Micro Trip* (23) *for Three-Wheeler* 

#### 3.4. Construction of Driving Cycle

Representative micro-trips were determined for each cluster for driving cycle development.

The micro-trips nearer to cluster centers were selected as representative micro-trips and this process was to select enough micro-trips from all clusters to develop candidate driving cycle. Performance value (PV) and sum squared difference (SSD) were used to select best driving cycle from all the candidate driving cycles. Performance value is the absolute sum of the difference between candidate cycle and target value. If the PV value is less, the real world driving pattern was represented more accurately. The candidate cycle with smallest PV value will be selected as the most representative driving cycle for the corresponding group. The PV value is given in Eq (1):

$$PV = |\theta_i - \theta_T|.W_T$$
(1)

Where,  $W_T$  is the transpose of the row weight vector corresponding to the set of statistics.  $\theta_i$  and  $\theta_T$  represents the five target parameters corresponding to the base data and candidate driving cycle. The weights assigned to five parameters were considered to be equal weight age because of the unavailability of the weights.

Mathematically SSD is given in Eq. (2). The candidate driving cycle with smallest SSD value is selected as representative driving cycle for the corresponding group.

$$SSD = \sum_{i=1}^{N_S} \sum_{j=1}^{N_a} (p_{ij} - q_{ij})^2$$
(2)

Where  $N_s$  is the speed classes,  $N_a$  is the number of acceleration classes,  $p_{ij}$  is the ij<sup>th</sup> entry of the candidate cycle, and  $q_{ij}$  is the ij<sup>th</sup> entry of SAPD of the overall driving speed profiles. It is the sum of the squared differences of the corresponding cells of the base SAPD and candidate driving cycles SAPD.

#### 4. Evaluation of the Driving Cycle

The developed driving cycle was compared with existing driving cycle and tabulated in Table 3. The comparison was done based on key parameters like percentage of acceleration, percentage of deceleration, percentage of idle, percentage of cruise and average speed. It was observed that, the percentage acceleration and percentage deceleration were high for developed driving cycle compared to other driving cycles. It means that, vehicle release more emissions and more pollution occurred if accelerations and decelerations were more. The average speed was observed to be more compared to others except Japanese and US driving cycles. The percentage of cruise and idle were observed to be less compared to others.

Driving Cycle Type	Speed	Cruise	Idle	Acceleration	Deceleration
ECE	18.35	29.23	30.7	21.54	18.46
Japanese	25.61	20.88	31.65	26.15	21.32
US 75	34.1	20.4	18	33.1	28.5
BDC	17.7	23.8	37.7	15.3	23.2
IDC	21.9	10.43	16.52	38.89	34.26
Pune	19.55	56.25	18.09	14.18	11.48
Present Study	24.83	2.392	5.404	50.997	41.174

#### Table 3

Comparison of Driving Cycle Parameters from Ludhiana to other Studies

#### 5. Conclusions

Driving cycle was developed for measuring the fuel emissions and consumptions. The driving cycle's were constructed mode wise and route wise and compared. The parameters like the percentage acceleration, percentage deceleration, idle, cruise and the average speed were used for developing the driving cycle. Driving cycle was constructed based on micro-trips and these micro-trips were obtained by dividing the base data. K-means clustering technique was used to group the micro-trips based on similarity. SAPD and SAPD matrixes were constructed and these were used for dividing the whole data into speed-acceleration ranges form. Based on PV and SSD representative driving cycle was selected from all candidate driving cycles. For all modes, (car, three-wheeler, and two-wheeler) time spent in acceleration and deceleration in Gill road is less compared to other driving cycles. For all routes, GT road, NH 95, Pakhwoal road, and Gill road time spent in acceleration and deceleration were high for two wheelers compared to other driving cycles. The developed driving cycle was compared with other driving cycles. Time spent in acceleration and deceleration modes for Ludhiana driving cycles are found to be significantly higher than Delhi driving cycles and also all other driving cycles.

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# IoT Based Water Purification Process using Ultrasonic Aquatic Sound Waves

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Date Written: 2020

#### Abstract

0.1

In modern human life has created a lot of innovations and it has improved drastically in advance Technology . Whenever a lot of innovations and advancements in technology will create pollution to natural resources like air, water, soil, etc. traditional methods such as biological process ,sand filtration ,carbon absorption ,chorine filtration will produce bi-products and creates many serious issues like cancer. In our proposed method Dust



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### IOT Based Smoke Test and Vehicle Pollution Control Montoring Using Nano Sensors

Ramanarayan Sankriti	
Esaiyarasi G	
R. Chandrasekaran	Issue
R. Srivel	Vol. 83: March/April 2020
	Section
Abstract	Articles
A motor vehicle emission produces of many air pollutants especially by	
internal combustion engines. And it is increasing every year. Each state has	
different licensing laws, continuing education requirements, training and	
testing requirements prior to issuing a license. So RFID is the powerful	

media for this Vehicle Insurance and smoke test monitoring for air Pollution related issues. Undoubtedly in modern world of urbanization, time and efficiency are matter of priority. IOT based papo sensor and frequency

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### Impact of Dyke on Hydrological and Hydrogeochemical Conditions in Nadergul Micro Watershed of Ranga Reddy District of Telangana State in India

Dr. A. Manjunath, Shilpa Mishra, Ramanarayan Sankriti, V. Shiva Chandra

#### Abstract

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Groundwater is the major source of drinking water in rural as well as in urban areas and over 94% of the drinking water demand is met by groundwater. The present work aims at finding the groundwater quality around Nadergul area and hence determining its suitability for drinking and irrigation purposes. This block has semiarid climate and people are mostly dependent on groundwater for irrigation. The groundwater quality of the area needs to be continuously monitored to get the long-term sustainability. In view of this, an attempt has been made to analyze the

# Solid State Technology

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### Cloud Computing based COVID-19 Patient Health Monitoring System to Create Safety Environment

Ramanarayan Sankriti, Ms. Yamini Kodali, Mrs. Perala Bhagyasri, Mr. Srikanth Nalluri

#### Abstract

Modern medical science using latest bio-medical instruments has made dramatic progress in prolonging life by overcoming disease. This project work falls under wireless biotelemetry and is designed with micro controller (Arduino), which is able to monitor two individual patients. The health parameters monitored for the two patients are different i.e., one patient's heart beat rate (number of beats) are monitored and the second patient's temperature and humidity are monitored. To achieve this, wireless communication technology (GSM) is used in this project. Whenever any of the parameters that are monitored goes abnormal, automatically a SMS is sent to the concern authorized person's mobile through the GSM modem

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Concrete is mostly used as a building material and while preparing concrete mix the natural resources are being used extensively. Due to large-scale construction being taken up, a steady sand mining is taking place at an alarming rate. To overcome the problem Vermiculite aggregate is partially used as a replacement to sand. Exfoliated Vermiculite (EV) can be effectively utilized in a silica-based material in building industry. In this present study, an attempt has been made to study the mechanical properties of EV cement mortar with different percentages of i.e. 5%, 10%, and 15% of Micro Silica and Ultrafine Fly Ash mineral admixtures as partial replacements of cement, and EV at 20%, 40%, 60%, and 80% by weight as partial replacement of fine aggregate. It has been observed that the required compressive and flexural strength of mortar are achieved when 10% Micro Silica and 5% Ultrafine Fly Ash are used as partial replacement by weight of cement and 20% EV is used as a partial replacement by weight of fine aggregate.

#### Keywords

# Estimation of Compressive Strength of Concrete by testing the Pozzolanic Reactions of Blended Cement Mortars using Bolomey's Equation

M.V.S.S.Sastri, K.Jagannadha Rao, V.Bhikshma

Abstract: To experimentally investigate the effect of the presence of Supplementary Cementitious Materials (SCMs) in concrete strength gain by using the efficiency factors in Bolomey's equation to the cement mortar. The quaternary blended cement mortar consists of Fly ash (FA) at 0, 20 and 30%, micro silica (SF) at 0, 5 and 10% and Nano silica (NSF) at 0, 2, 3 and 6% replacement to cement. To study the compressive and flexural strength of mortars a total of 63 mortar mixes, with a cement-sand ratio of 1:2.75 were cast and tested; out of these mixes, 27 were variable w/b ratios based on consistency and remaining 36 were with fixed w/b ratio of 0.485. The mixes using SF and NSF had shown an improved performance while FA at 20% optimum indicated strength on par with the control mix. In triple blended mixes, all the combinations of NSF-SF, NSF-FA and SF-FA improved the performance of mortar. Bolomey's equation was used to find the Efficiency of SCMs in mortar and concrete mixtures. Concrete mixes with two different cement contents along with a confirmation test using another cement quantity were carried out to identify optimum proportions of quaternary blended mixtures.

Keywords: Bolomey's Equation, Consistency, Initial setting time, Quaternary blended mixes, Supplementary Cementitious Materials.

#### HIGHLIGHTS:

- Utilization of waste materials using Bolomey's equation while making Cement mortar and concrete making.
- Relating the efficiency of pozzolans in a mortar with concrete by using Bolomey's equation.

• Workability of Supplementary Cementitious Materials was identified by consistency, Initial setting time with reliability.

#### Manuscript published on 30 September 2019 \* Correspondence Author

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#### I. INTRODUCTION

T he utilization of chemical admixtures and a large quantity of OPC is one of the causes of increasing the cost of High Strength Concrete. Smith <sup>[1]</sup> defined the cementing efficiency factor 'k' of pozzolana by which the amount of cement it could replace changing the property to be investigated; typically the compressive strength (CS) is a factor related to many properties of concrete. It was initially applied to fly ash, and later many authors utilized this concept to all pozzolanic materials. Neville<sup>[2]</sup> has stated that by controlling the performance of cement mortar in concrete, a stronger concrete can be made. Therefore, several researchers carried out investigations to alter the properties of cement mortar and paste by using finely divided pozzolanic materials, which is an excellent alternative to reduce the cost, especially if they are industrial by-products or wastes. Nielsen<sup>[3]</sup> had proved that Bolomey's expression relating the strength of concrete could also be applied to hardened cement pastes when w/c > 0.15 and also proposed two expressions with w/cless than and more than 0.4. Ganesh Babu and Nageswara Rao<sup>[4]</sup> proposed three efficiency factors for pozzolans in concrete after conducting tests on fly ash, micro silica and GGBS. Appa Rao<sup>[5]</sup> proved that the modified Abram's and Bolomey's equations give reasonably good predictions of the CS of mortar mixes. Tangpagasit et al.<sup>[6]</sup> had shown that pozzolanic reaction of fly ash mortar depends on the average size of particle and curing period. Considering Abram's law, Wong and Abdul Razak<sup>[7]</sup> recommended an approach for the evaluation of relative strength of pozzolanic material and also stated that before any mix design the 'k' value has to be re-ascertained. Erdem and KIrca<sup>[8]</sup> had stated that by mixing two pozzolanic materials can compensate for the shortcomings of the other material. Due to the rapid progress in Nanotechnology, new materials of Nano-scale with highly improved characteristics are available. Qing et al.<sup>[9]</sup> has stated that micro silica is a standard pozzolana for use in High strength concrete (HSC), but based on experimentation the pozzolanic activity of NSF is higher than SF hence a small amount of NSF can effectively digest Calcium Hydroxide (CH) at early ages when used along with SF and FA.

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#### Estimation of Compressive Strength of Concrete by testing the Pozzolanic Reactions of Blended Cement Mortars using Bolomey's Equation

Shih et al.<sup>[10]</sup> utilized small dosages of NSF in mortar making and found that the strength of mortar increased up to 14 days of curing later, the increment is decreasing. Ltifi et al.<sup>[11]</sup> concluded that due to the presence of NSF, the microstructure had become dense, and hence, mechanical properties had improved. Hou *et al.*<sup>[12]</sup> and Pacheco-Torgal *et* al.<sup>[13]</sup> have stated that there is a significant change in the mechanical and microstructural performance in all of the cementitious composites by adding nanoparticles. Heikal et al.<sup>[14]</sup> studied the ternary mixtures of NSF and GGBFS combination on standard consistency, setting times and CS at different ages of 3 to 90 days and concluded that water demand increased and setting times decreased due to the presence of NSF. The CS and flexural strengths observed were more than control concrete. The investigations of Mukharjee and Barai<sup>[15]</sup> have indicated that the levels of interaction of NSF on w/c ratio were not significant on CS, but individually they are causing the dominant effect on CS. Li et al.<sup>[16]</sup> has stated NSF is more efficient in improving the mechanical properties of mortars as compared to other pozzolans. The combination of SF and NSF gives an effective combination of strength improvement, and its combination is more synergetic on densifying the microstructure of the hardened paste. They concluded that SP demand for 2% NSF is comparable to that of 10% of SF and also NSF alone should not be used for maximum performance. Determination of the ideal mixtures of materials depends upon several factors and performance constraints. The properties of the final product can be simplified with the utilization of efficiency factor design, and the objective of this investigation is to obtain optimum proportions suitable for the quaternary mixture of paste and mortar. The study also focuses on the generalization of Bolomey's equation and identifying the efficiency constants for pozzolans in quaternary blended mortars which can be utilized for the making of concrete with a minimum number of trials for desired strength.

#### II. RESEARCH SIGNIFICANCE

There is a need for minimizing the wastage while designing the concrete mixes and also reduce its volume as a large quantity of natural aggregates is being used for the identification of appropriate optimum combinations. If research can show that mortar can be used for evaluating some basic parameters along with pozzolans, the economic benefits could be realized. This research programme evaluated the consistency of cement paste along with pozzolans for water demand, setting times, the CS and flexural strength of mortar mixes. Results of this work indicate that the specimens of both blended cement mortars and concrete can effectively show the pozzolanic reactions while achieving the strength. A satisfactory correlation between the pozzolanic action of the ingredients in mortars and concrete was observed, which reduces the volume of material in concrete to be cast for proper mix design. Based on the results of the investigation, modified Bolomey's equation can be used after identifying the efficiency factors of pozzolans in mortars and concrete with minimal experiments.

#### III. MATERIALS AND METHODOLOGY

#### A. Materials Used

- *Cement:* Commercially available OPC 53-grade cement conforming to IS 12269-2013<sup>[17]]</sup> was used for preparing paste and mortar whose properties were tabulated in Table 1. The available Potable water was used for casting.
- *Nano-Silica* is in a colloidal form and stabilized, and it is convenient to use due to easy dispersion, according to Quercia *et al.*<sup>[18]</sup>. For the experimentation, the commercially available product was used.
- *Fly Ash* particles are typically spherical and finer than OPC. Raw Fly-Ash (as brought from the source) cannot be used as it requires processing to work efficiently in concrete. Therefore a processed Fly-Ash named 'Pozzocrete 60'is used. It is manufactured by DIRK India Pvt. Ltd., Nashik and satisfies the specifications as per IS: 3812(Part-1):2013<sup>[19]</sup>.
- *Micro Silica* The material is procured from M/s ELKEM Mumbai.
- *Fine Aggregate* The study is of comparative hence Local River sand of 4.75 down as per I.S.Seive and held on 150micron was used for preparing the mortars and concrete. The Grain size distribution of sand shows that it is close to the zone-III of IS:383-2011<sup>[20]</sup>.
- *The coarse aggregate* is passing through 20mm and is angular material in shape.
- *Superplasticizer* is obtained from M/s Fosroc of Sulphonated Naphthalene Polymers conforming to ASTM C494 as Type A and Type F.

#### IV. PREPARATION OF SPECIMENS AND TESTS CONDUCTED

The preparation of samples was done in three stages. In the first phase, the consistency and setting time tests on paste were performed. In the second stage with the w/b at a calculated value based on Normal consistency test was used. In phase III, a constant value of 0.485 was used, and a small percentage of Superplasticizer was added for maintaining the flow.

Vicat apparatus was used for determining the Consistency and setting times of quaternary blended cement pastes as per IS 5513:1996<sup>[21]</sup>. The mixing was done mechanically by employing mixing apparatus as specified in Planetary Mixer conforming to IS 10890:1994<sup>[22]</sup>. The mortar flow was checked for a  $110\pm 5$  at 25 drops IS 5512-1983<sup>[23]</sup>. Freshly prepared cement mortars were moulded in 50mm x 50mm x 50 mm cube moulds, and after one day, the hardened mortar samples were kept in curing tank. The specimens were tested under 3000 kN compression testing machine at 0.01 MPa/sec as per IS 516-1959<sup>[24]</sup>.

Two numbers of 40mm x 40mm x 160mm Prisms were cast and tested under three-point loading using a flexural instrument at a rate of 1.25mm/min loading rate at 56 days of curing as per ASTM C348-14<sup>[25]</sup>.

The parametric study



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includes flow tests for the determination of workability, mortar cube CS tests after 7 and 28 days of curing, flexural strength tests and also CS tests on broken pieces of prisms obtained from flexure test.

#### V. RESULTS AND DISCUSSION

#### A. Standard Consistency and Setting Times of Cement

The nomenclatures of mixes are defined in Table 2 and Referring to Fig.1 and based on regression analysis; it is observed that the variables are independently affecting the Consistency of cement paste. The presence of SF and NSF in the paste is increasing the water demand up to 50% and decreasing the setting times due to their fineness of particle size. The effect of FA is negligible on Consistency and IST as the p-value is above 0.05. The adj.R<sup>2</sup> value of consistency and setting time is at 79%.

The regression equation for Consistency (CON) is

CON=29.2+1.9 x NSF% +0.73 x SF%(1)

The regression equation for Initial Setting Time (IST) is IST = 69.68-6.7 X NSF%-1.36 X SF% (2)

After collecting the data of water requirement from the Consistency test on cement paste, cement mortar cubes were cast with 1:2.75 binders to sand ratio with variable water quantity. A total of 27 mixes were cast, and the test is conducted according to ASTM C 109/C109M  $(2012)^{[26]}$ .

# **B.** Influence of binary blending on mortar mix with a variable w/b ratio.

Figure 2 shows a slight reduction or no change in water demand when FA is used in binary mixes, which are as observed by Mora *et al.*<sup>[27]</sup> while the water demand was increased for SF and NSF. The strength of 5% SF mortar is higher and also has more water demand than the control mix. The strength of the control mix is almost reached for the blend with 3% NSF though there was a higher water demand by 27%. It is understood that higher strengths than the control mix can be obtained with binary blends with NSF and SF by reducing the w/b ratio. However, Superplasticizer has to be used to meet the workability requirements. Based on the regression analysis the 7D and 28D cured mortar cubes have Adj R<sup>2</sup> is 95% and 85% the p-value is nearer to 0.05 for NSF and FA, and other variables are not much effective on the 7D and 28D CS.

# **C.** Influence of triple blending on mortar CS and water demand.

Figure 3 shows the influence of triple blending on mortar CS. When the triple blending of mortar is done by the FA and SF for the higher w/b ratios, the CS is decreasing up to a maximum of 52%. The blending of NSF and FA is also showing the same result, but a little gain in strength is observed when compared to the fly ash mortar cube. This gain in strength may be attributed to the presence of NSF. Though there is a reduction in strength of ternary mixes with NSF and SF compared to control due to increased w/b ratio, there is an improvement in strength gain compared to ternary mixes using fly ash. The regression analysis with Adj. R<sup>2</sup> equal to 82% also shows that FA and NSF are significant in contributing strength to the mortar cubes.

#### **D.** Influence of quaternary blending on mortar cubes

Figure 4 shows the variation in the strength of mortar cubes with NSF, SF and FA, which has a positive effect, but there is a higher demand for water for workability. This had resulted in a reduction in the strength, which satisfies the Abram's Law. Table 3 displays the ANOVA results for the variables used in the model, which had a high  $R^2$  and adj.  $R^2$  values. This indicates a high impact on the experimental results. In addition, the results of the F-test had higher values than the F critical, which point towards their importance in making the mortar strong. Therefore, these variables are significant and had a predictive capacity.

#### VI. INFLUENCE OF POZZOLANS ON MORTAR CUBE CS WITH FIXED W/B OF 0.485.

It is observed that water addition is affecting the strengths considerably in the earlier phase of work and hence to know the reactivity of pozzolans, the w/b was constant at 0.485. Figure 5 show that the blending of cement with pozzolans has a positive effect with increased CS at different ages.

The CS was assessed by using the Modified Bolomey's Equation. In this equation, the additive constant is taken as 0.5 based on recommendations of Rajamane<sup>[28],</sup> which is in good correlation with the Indian Cement brands while designing the mixtures. The Cementing Efficiency Factor is defined as the ratio of the cementing efficiency of FA, SF and NSF to the cementing efficiency of the cement to which these admixtures were added.

$$\sigma c = A \times \left[ \frac{(C + K1 * nS + K2 * SF + K3 * FA)}{W} - 0.5 \right]$$
(3)

Using MATLAB, the constants of the equation were calculated and given in Table 4. The equation under consideration is following the trends as specified by the earlier researchers. The efficiency of Nano silica is higher at 7days, but its value is decreasing with age, and the efficiencies of FA and SF are improving with age which is also confirming the test results as reported by Zhang and Islam<sup>[29]</sup>.

#### A. Analysis of Mortar Cube Strengths Using Minitab-16.

Minitab is one of the powerful statistical tools for regression analysis to find the effects of the variables on the main parameters of strength. The regression equations for 7 and 28 days were obtained and found that when NSF and SF were combined with FA, they are losing their significance in enhancing the CS of mortar cubes (p-value less than 0.05). The only parameter affecting the strength is FA. The regression equations for 7, 28 and 56 days CS is given below. 7D CS=  $26.8+0.2 \times NSF\% - 0.3 \times SF\% - 0.29 \times FA\%$  (4) 28D CS=  $40.87 - 0.075 \times NSF\% - 0.31 \times SF\% - 0.43 \times FA\%$  (5)

# 56D CS= 44.75 – 0.49 x NSF% - 0.296 x SF% - 0.31 x FA% (6)

The Pareto diagram indicates FA has a significant effect on the 7, 28 CS of mortar cube strength. From the Figs. 6, 7 and 8, it is observed that 3% NSF is

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more effective in improving the strength of mortar and 5% SF and 20% FA combination along with NSF can give an average strength of mortar (mean value as per the graphs). In addition to this 10%SF and 20%, FA combination along with NSF is also offering an approximately same result at 56 days of curing. Hence a combination of 20% FA, 10% SF and 2% NSF provides an economical mix with more saving on cement.

#### VII. CALCULATION OF BOLOMEY'S CONSTANTS IN CONCRETE

Neville and Aitcin<sup>[30]</sup> observed that for making a high-performance concrete, the binder content could be up to 600kg/m<sup>3</sup> with a combination of Portland cement, FA, SF and NSF. To study the pozzolana effect on concrete with efficiency factors, two grades of concrete with cement at 500 and 650kg/m<sup>3</sup> with fixed water binder ratio were cast and tested. Substituting the values of these quantities in Bolomey's equation, the constants were calculated and given in Table 5.

To validate the efficiency factors, a concrete containing  $450 \text{ kg/m}^3$  of cement with fixed 10% SF and 20% FA and 2-3% of Nano silica was tested for CS. The results are compared by a statistical term of Mean Absolute Percentage Error (MAPE).

$$MAPE = \sum_{i=1}^{n} \left| \frac{observed strength - predicted strength}{observed strength} \times 100 \right| \%$$
(7)

The observed values and predicted CS was within 10% error. The trend in the strength gain of concrete with pozzolans is similar to blended mortars, and the variation in the efficiency factors of concrete is the same as those of mortar. Hence by testing of cement mortars, an efficient concrete with pozzolanic materials can be obtained.

#### VIII. RESULTS OF FLEXURAL STRENGTH

Figure 10 illustrates the flexural strength variation, and when the results of compression and flexure were analysed, the following relation is obtained:

 $f_k = 0.91 \times \sqrt{f_{ck}}$  or equivalent to  $f_k = 0.15 \times f_{ck}$  (where  $f_{ck}=56$  day CS of mortar) The values obtained by this relation are lower than the results obtained by Haach *et al.*<sup>[31]</sup>

#### A. Influence of pozzolans on flexural strength of prisms.

The flexural strength is increasing up to 20% FA, and with 30% FA, the strength is reduced to 8% (Fig. 10). The trend is the same as that reported by Siddique<sup>[32]</sup>. Addition of 5% SF improved the strength by over 36% than the control mix and the raise in strength is only 10% when 10% SF was used which is similar as reported by Appa Rao<sup>[33]</sup>. The presence of NSF at all levels is showing an improved performance up to a maximum of 76% with 2%NSF. The blending of SF and FA at 10% and 20% respectively is showing a maximum increase in the strength by 34% compared to the control mix. The strength of mortar with FA and NSF is more than that of control mix, reaching a maximum of 68% with 3% NSF and 20% FA. The ternary blend of SF and NSF is also reaching a maximum value of 60% with 3%NSF and 5% SF.

up to a maximum of 48% with 2%NSF, 5%SF and 20% of FA and the results are stabilized at 10%SF with a reduction in strength on further increase in dosages of NSF. In all the above tests, the prisms failed suddenly indicating brittle failure.

Flexural strength (MPa) = 5.90 - 0.156 x NSF% -0.047 x SF% - 0.03 x FA% (8)

#### IX. OPTIMUM MIXES

On the whole, referring to the figures 6, 7 and 8 of main effect plots, the mixes having 20% fly ash, 5% SF and 3% NSF as a partial replacement of cement are giving optimum strengths. But to get optimum utilization of Cement in concrete at higher ages, i.e. at 56 days of curing and referring to Fig. 9, a combination of 20% fly ash, 10% SF and 2% NSF as a replacement to cement may be considered.

#### X. CONCLUSIONS

Conclusions drawn from the experimental investigation are

- The addition of Silica Fume and Nano silica decreased the consistency of cement paste, increasing water demand while a marginal increase in the consistency was observed with the addition of Fly ash.
- The setting times were decreased by the addition of Silica Fume and Nano silica, which indicates the necessity of retarder to maintain the plasticity of concrete.
- Equations were proposed for estimating consistency and initial setting time with an R<sup>2</sup> value of 78%.
- The 28-day CS of triple blended mortars with fixed w/c ratio was reduced marginally.
- The optimum percentages of pozzolans in quaternary blended mortars / concretes are obtained as 20% fly ash, 5% SF and 3% NSF considering the CS at 28 days and optimum percentages are 20% fly ash, 10% SF and 2% NSF corresponding to the CS at 56 days.
- The flexural strength is increased to the tune of 76% when 2 to 3% cement is replaced by NSF
- The flexural strength of mortar prisms is found to be optimum in quarternary mixes when cement is replaced by FA, SF and NSF by 20%, 5% and 2 or 3% respectively. The maximum increase in strength is to the tune of 50%.
- The proposed equation expressing the flexural strength in terms of CS is predicting the flexural strength with more than 90% accuracy.
- The presence of fly ash in the mix improved the workability, while the presence of SF or NSF enhanced the strength of both concrete and mortar.
- By using the efficiency factors, Modified Bolomey's equation predicts the CS of concrete reasonably.

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#### Estimation of Compressive Strength of Concrete by testing the Pozzolanic Reactions of Blended Cement Mortars using Bolomey's Equation

		OPC	Fly ash (FA)*	Micro silica (SF)*	Nano silica (NSF)*
Chemical composition (%)	CaO	63.4	3.9	0.2	-
	SiO <sub>2</sub>	20.1	46.3	95.9	>99.8*
	Al <sub>2</sub> O <sub>3</sub>	4.1	28.5	0.3	-
	Fe <sub>2</sub> O <sub>3</sub>	3.3	18.5	0.3	-
	MgO	3.6	1.8	0.4	-
	Na <sub>2</sub> O	0.2	0.2	0.05	-
	K <sub>2</sub> O	0.4	0.6	0.6	-
	SO <sub>3</sub>	2.1	0.2	0.2	-
	LOI	2.4	2.3	1.5	-
Mineral phases (%)	C <sub>3</sub> S	66.8	-	-	-
	C <sub>2</sub> S	7.3			
	C <sub>3</sub> A	5.3			
	C <sub>4</sub> AF	10.1			
Physical properties (%)	Blain fineness (m <sup>2</sup> /kg)	308			
	BET surface area (m <sup>2</sup> /g)	-	-	21.3	200.1
	Average primary particle size	28.2 μm	27.3 µm	150nm	12nm
	Specific gravity	3.15	2.5	2.2	2.2

#### Table 1: Physical properties and chemical composition of materials

\*Information provided by the supplier.

#### Table 2:Nomenclature of the mortar mixes used for setting time and consistency and other mechanical tests.

Mixes with Variable w/b	Mixes with fixed w/b	mix	cement	NSF	SF	FA
A1	B1	(0,0,0)	100	0	0	0
A2	B2	(0,0,20)	80	0	0	20
A3	B3	(0,0,30)	70	0	0	30

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Mixes with Variable w/b	Mixes with fixed w/b	mix	cement	NSF	SF	FA
A4	B4	(0,5,0)	95	0	5	0
A5	B5	(0,5,20)	75	0	5	20
A6	B6	(0,5,30)	65	0	5	30
A7	B7	(0,10,0)	90	0	10	0
A8	B8	(0,10,20)	70	0	10	20
A9	B9	(0,10,30)	60	0	10	30
NC	B10	(2,0,0)	98	2	0	0
NC	B11	(2,0,20)	78	2	0	20
NC	B12	(2,0,30)	68	2	0	30
NC	B13	(2,5,0)	93	2	5	0
NC	B14	(2,5,20)	73	2	5	20
NC	B15	(2,5,30)	63	2	5	30
NC	B16	(2,10,0)	88	2	10	0
NC	B17	(2,10,20)	68	2	10	20
NC	B18	(2,10,30)	58	2	10	30
A10	B19	(3,0,0)	97	3	0	0
A11	B20	(3,0,20)	77	3	0	20
A12	B21	(3,0,30)	67	3	0	30
A13	B22	(3,5,0)	92	3	5	0
A14	B23	(3,5,20)	72	3	5	20
A15	B24	(3,5,30)	62	3	5	30
A16	B25	(3,10,0)	87	3	10	0
A17	B26	(3,10,20)	67	3	10	20
A18	B27	(3,10,30)	57	3	10	30
A19	B28	(6,0,0)	94	6	0	0
A20	B29	(6,0,20)	74	6	0	20
A21	B30	(6,0,30)	64	6	0	30
A22	B31	(6,5,0)	89	6	5	0
A23	B32	(6,5,20)	69	6	5	20
A24	B33	(6,5,30)	59	6	5	30
A25	B34	(6,10,0)	84	6	10	0
A26	B35	(6,10,20)	64	6	10	20
A27	B36	(6,10,30)	54	6	10	30

\*NC: Not Prepared

#### Table 3: ANOVA results for 7D CS of mortars with variable w/b ratio.

	df	SS	MS	F	Significance F					
Regression	4	226.8705	56.71762	16.3009	0.000651					
Residual	8	27.83533	3.479417							
Total	12	254.7058								
ANOVA results for 28D CS strength of mortars with variable w/h ratio										

ANOVA results for 28D CS strength of mortars with variable w/b ratio



#### Estimation of Compressive Strength of Concrete by testing the Pozzolanic Reactions of Blended Cement Mortars using Bolomey's Equation

	df	SS	MS	F	Significance F
Regression	4	238.1078	59.52696	2.949534	0.09021
Residual	8	161.4546	20.18182		
Total	12	399.5624			

Table 4. Modified Bolomey's equation constants

Constants		Coefficients obtained at different ages				
		7D	28D	56D		
А	А	15.69	25.80	28.65		
nS	K1	1.92	0.62	0.17		
SF	K2	0.25	0.64	0.50		
FA	K3	0.14	0.16	0.47		

Table 5: Efficiency factors of pozzolans in concrete based on Bolomey's Equation.

CONSTANTS		Coefficients 28D	
А	А	25.457	
NSF	K1	1.328	
SF	K2	0.748	
FA	K3	0.340	



#### Fig. 1:Variation of consistency and setting times in different mixes





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Fig. 3. Compressive strength of quaternary blended mortar cubes using Nano silica.

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#### Estimation of Compressive Strength of Concrete by testing the Pozzolanic Reactions of Blended Cement Mortars using **Bolomey's Equation**



Fig. 6: Main effects plot for 7 Days compressive strength



Fig. 5: Main effects plot for 28Days compressive strength



Fig. 6: Main effects plot for 56Days compressive strength



Fig. 9: Main effects plot for 56Days flexural strength



Fig. 7: Flexural strength of cement mortar beams



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# Transforming Lead-Free Fuel: Filter less Filtration Process by using Ultrasonic Waves

#### R. Srivel, Ramanarayan Sankriti, P.Nandha Kumar

Abstract— The main objective of the study is focused on removing the impurities in fuel substances. In the filtration process, sound waves are passed, as the longitudinal wave is also called as a compression wave. Ultrasonic signals are created with the help of transformer and that feeds into the transducer. When the output of the transducer is passed to the liquid medium it collides with dust particles and pushes the dust particles downwards. The subsequent ultrasonic waves retain the impurities in the bottom. Then the pure material is obtained in the upper part and the impurities in the bottom are removed by opening the lower part. The proposed method of ultrasonic filter will filter the dust particles in the liquid using polystyrene microscope and frequency sweep techniques, it generates the constant longitudinal ultrasonic waves in horizontal direction of a glass tube having large radius. This method makes the dust particles to settle down at the bottom and pure liquid will be present at the top layer.

Keywords—Filtration, transducer, micro-particle, ultrasonic waves

#### I. INTRODUCTION

The density of micro-particle is manipulating caused by unleaded fuel. This method helps to trap, sort, and filter the unleaded fuel into a purified fuel which is a crucial process in the field of Automobile technology. It can improve the engine performance and also better the mileage. However, in today's petroleum market the available of liquid contains a high level of lead particles that creates very serious environmental issues and various hazards on the human's health (1).

There are various methods for identifying micro-particle manipulations based on the physical principles which have identified by adding optical radiation force and electrostatic force. For example, the manipulation of bio-cells identified in biotechnology is practically possible. the proposed ultrasonic filtration method uses Electronic timer circuit is used to give an timing pulse to frequency sweep technique to generates a constant longitudinal aquatic ultra-sonic Aquatic sound waves inside the liquid in horizontal (longitudinal) direction.which creates a constant vibration inside the liquid and it makes the micro dust particles to move towards at pressure node or anti node.[5]

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This makes the microscopic dust particles to vibrate and to settle down at specific region of the channel the remaining liquids are allowed to flow through the different outlet of the glass tube, without using any barrier filter inside the tube. In existing method [6],[7] such as barrier filtration and centrifugal filter uses a separate filter membrane inside the glass tube to filter the dust particle, in that method even though the microscopic dust particles will still exist in the liquid layer.

The frequency sweep technique generates the ultra-sonic aquatic sound waves with respect to frequency in the range of few MHZ to GHZ. The deviation in the frequency will reduces the filter efficiency. In such cases the node plane should be situated at the center of the channel in order to protect the resonance of the frequency. In the proposed method we constructed the node plane is placed at the center of the channel and creates a two outlet in the glass tube having large diameter. One outlet is used to collect the purified liquid and another outlet is used to collect the dust particles. The based on different time periods the frequency sweep techniques generates different frequency based on the user selection of dust particles size.



Fig longitudinal waves

Our proposed technique will make a simple flow-through filtration method by using frequency sweep technique. In the proposed approach, the direction of the ultra-sonic sound waves will create an acoustic radiation force on microscopic dust particles is perpendicular to the direction of liquid flow, whereby radiation force by the created by small ultra-sonic aquatic longitudinal waves can translocate microscopic dust particles instantly. The modularized device with narrow channel is made of steel and acrylic fiber.

#### **II. EXISTING SYSTEM**

Coarse filtration, microfiltration, ultrafiltration, reverse osmosis, distillation are the existing systems for purification. Distillation method: The action of purifying a liquid by a process of heating and cooling. The major drawbacks of

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existing system require a Separate filter membrane and distillation process needs a large amount of energy, boiling point of water. Even though the microscopic dust particles will still exist in the liquid layer and it cannot be removed efficiently and the entire existing filtration method requires a high cost.

#### **III. PROPOSED SYSTEM**

The main objective of the Proposed system is to remove the impurities in liquid substance. The user selectable particle size and no filter medium is required. For this filtration process ultra-sonic sound waves are passed as a longitudinal wave to vibrate in the glass tube having a large diameter. It used frequency sweep technique to generate the constant longitudinal ultra-sonic sound waves inside the liquid. Ultrasonic wave signals are created with the help of transformer and fed it into transducer. The output of transducer has ultra-sonic longitudinal waves is passed through the liquid medium. Due to constant vibration of longitudinal ultra-sonic sound waves using frequency sweep technique will make the microscopic dust particles to move in nodal and anti-nodal direction. Then, it pushes the particles downwards and pure material is obtained in the upper part.

#### Α. Merits

The major merits of this method:

- No filter medium is required 1.
- 2. Clotting does not occur.
- 3. User selectable particle size.
- 4. Cost is low
- Α. Block Diagram of the system:



Fig. 1. Block Diagram of the system

#### B.Transformer :-

In this method we have used two types of transformer the reduce and increase the power supply voltage varies from 0V to 230 Volts. The transformer used to reduce the input power supply voltage by 7.5Volts. And the reduced input power supply voltage is given as an input to one end of the transducer. And second transformer will increase the input power supply voltage by 17.5 volts. The increased output voltage is given as a input to another terminal of the transducer. The figure shows the output voltage of the transformer.



Fig: Voltage waveform of Transformer

#### C.Transducer :

Transducer is a device which is used to convert physical form of energy into Electrical signals either voltage or current. In our proposed method the output of transformer is connected to the transducer to convert the electrical signal into an Electronic ultra-sonic aquatic sound waves to generate inside the liquid. The transducer consists of an acrylic fibre and LEAD ZIRCONATE TITANATE (PZT) using piezo electric effect & Electronic timer control circuit method, it generates a different frequency based on the time period to produce the longitudinal ultra-sonic aquatic sound waves at constant vibration inside the glass tube to filter the dust particles in the liquid.





Fig a transducer connection

fig b transducer three-dimensional view

D. Properties of ultrasonic waves: -

1. It is an energetic wave.

2. Frequency range from 20KHz to several giga Hertz

3. These waves travel with in a same velocity of light in a given medium.

4. These waves can filter the microscopic plastics particles, small metals etc.

5. These can produce oscillations in low viscosity liquids.

6. The ultrasonic waves are following the same principle of light waves.

E.Characteristics of Acrylic fiber:

1. It is made up of polyacrylonitrile polymer.

2. Acrylic Fiber are the High Performance Fiber.

3. It contain 85% acrylonitrile monomer.

4. it is also called as Synthetic Fiber.

4. It absorbs the sound waves and it doesn't emit the sound waves.

5. It have low elasticity and it have an elongation increases when wet.



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F.Characteristic of LEAD ZIRCONATE TITANATE (PZT):

1. PZT develops a voltage (or potential difference) across two of its faces when

compressed

It is doped either acceptor or donor, because it is 2. not used in pure form.

By using a piezo electric principle, it generates a 3. constant frequency of oscillation.

- 4. This material is placed in the mid of transducer.
- 5. It can transmit and receive high frequency.
- High sensitivity for active or passive use. 6.

#### **IV. CONSTANT FREOUENCY GENERATION** USING ELECTRONIC TIMER CIRCUIT.

The Transducer produces Electrical signal voltage as the output and it is passed to the Piezo electric material called LEAD ZIRCONATE TITANATE (PZT). It receives the input from the transducer, based on the transducer output voltage the Piezo Electric Material (PZT) works on the piezo electric effect and it generates a constant Frequency of oscillations. the generated constant frequency is passed to the Electronic frequency Sweep Technique to generate the Ultra-sonic constant aquatic sound waves inside the liquid inside the glass tube having a large radius.

The generated Ultra-sonic constant aquatic sound waves creates a constant acoustic radiative vibration force with respect to frequency. The liquid present inside the glass tube will starts to oscillate in up and down due to constant acoustic radiation force, Due to this constant vibration it makes the micro dust particles to move towards at anti node i.e. at the bottom layer. The filter liquid will be present in the top layer. This microscopic dust particles have to vibrate and to settle down at specific region of the channel the remaining liquids are allowed to flow through the different outlet of the glass tube.

In our proposed method we constructed the node plane is placed at the center of the channel and creates a two outlet in the glass tube having large diameter. One outlet is used to collect the purified liquid and another outlet is used to collect the dust particles. The modularized device with narrow channel is made of steel and acrylic fiber. The acrylic fiber is used for producing more damping when the ultrasonic aquatic sound waves is passed inside the liquid.

Туре	Lengt h(mm)	Weig ht(g)	Frequenc y(KHz)	Reson ance Imped ance (Ω)	Stat ic Cap acit y (F) ±10 %	In pu t Po we r( W )
UCE- UT- 1355 0 PZT- 4	54	215	40	10-20	420 0	50

Table

Inside the glass tube the fluid consists of many dust particles such as small ceramic particles, bacteria cell and small polystyrene beads, when the ultra-sonic aquatic sound waves varies with respect to frequency in the range of few MHZ to GHZ. The deviation in the frequency will reduces the filter efficiency. In such cases the node plane should be situated at the center of the channel in order to protect the resonance of the frequency



Fig Shows the Hardware connections

#### . V. ELECTRONIC TIMER CIRCUIT TO **GENERATE PERIODICAL FREQUENCY &** RESULTS

Due to variation in frequency range in the order of MHZ to GHZ. Either it increases or decreases the aquatic sound vibration inside the liquid. Due to this it decreases the efficiency of the filtration process. And some of the dust particle still present inside the liquid. In order to increase the efficiency of the filtration process we are using an Electronic timer circuit to used to avoid the sudden increase and Decrease in frequency.



#### VI. FREQUENCY VIBRATION IN LEAD ZIRCONATE TITANATE (PZT) USING TIMER CONTROL CIRCUIT

In our proposed Method we use Electronic timer circuit to generate the particular time period of frequency to filter the dust particles such as (SIC), polystyrene dust particles, lead and small plastic dust particles. In this proposed method the user has to select the time period based on the dust particles. For dust particle such as SIC the time period should be selected as t= '1' and for polystyrene Dust particle time period should t= '3' seconds should be set in timer circuit. So that for the particular time duration it generates the ultrasonic aquatic sound waves with respect to particular

frequency, it will produce the vibration inside the liquid and

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then it filter the dust particles at the bottom layer of the glass tube.

#### **VII. CONCLUSION**

In our above investigation, the ultra-sonic aquatic sound waves generation using frequency sweep technique will to filter the Microscopic dust particles like Sic and polystyrene diluted in liquid with the flow rate of 0.1 ml/min. our proposed filtration method, the frequency range and sweep time period calculated, as t= 1 seconds for SIC Dust particles and t= 3 seconds for Polystyrene particles were determined to filter the dust particles present in liquid. For the liquid flow filtration experiments requires a large microchannel device made of steel and acrylic was manufactured. The proposed method shows the successful results in filtration performance on dust particles present inside the liquid. This method can be practically implemented in operating micro-fluidic devices to filter the impurities present in the liquid.

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## Smart Automation Technique to Collect Dry and Wet Waste using IOT Module: to Achieve our 'SBM' Mission

#### C.Jenifa Latha, Ramanarayan Sankriti, M.Chandra sekhar

Abstract— The global waste production in now a days is increasing at a rapid rate, it is predicated that it will give rise to 28 billion tonnes per vear by 2051, one-third of the whole global Asian continent is majorly contributed by India and china. The Main objective of the proposed method is to achieve clean India mission abbreviated as SBM. To make our urban and rural areas surrounding to be clean without any dry and wet waste. So our proposed method is designed to collect dry and wet Waste using IOT and embedded system Technology. The government has provided two dustbins in every place to dump the waste, one for dry waste and other for wet waste. The sensors node is kept inside the dustbins. When it becomes full it sends the signal to the Transmitter node. After Receiving the signal from sensor node, it updates details area and location in the common cloud IOT database. Then it sends the information to particular Location vehicle Driver to collect the waste.in the vehicle it has separate provision to collect dry and wet wate using conveyor belt and hbridge motor driver circuit. After collecting the waste it updates the information to the common cloud database system. node

#### I. INTRODUCTION

In our country India producing nearly 58 million tonnes of waste per year. The per capita of waste generated in our country India ranges from 0.199 Kg to 0.599 Kg. It is predicated that, especially in developed citys, produces 0.7 kg of waste per person per day. The advance development and growth in industry automations have created a major impact on the environment by affecting land, water, air, and noise pollution Due to this it reduces our purity in natural air, good water becomes polluted water. these things will lead to global warming, greenhouse gas, acid rain, etc. Dumping of huge plastic waste will affect the drought, as it gives chances to reduce our natural rainfall. The 75% of total waste will spoils our natural surrounding environment. ,by observing all the natural calamities it gives suggestions to dispose the waste materials properly without affecting the environment .This improper disposal of waste causes infectious and chronic diseases to humans and animals. The various charts show in the figure shows the total percentage of waste produced in every country

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16 14 Harvest 12 Post-Harest 10 8 ■Processing& б Packaging 4 Distribution 2 Consumption Ω Europe & N.American & Japan & China Latin America N Africa & Sub Sahara Southeast Asia West&Central Asia Africa

Chart 1: Percentage of World Food Wastage



#### Chart 3: Percentage of Electronic Waste, Incinerated and Recycled



HE

#### **II. PROPOSED METHOD**

Generally, in Electronics Arduino is a open-source platform based on different embedded micro-controllers such as AVR, ARM, Atmega-8 etc. and it made ease of use in hardware interfacing device modules such as sensors, GPS, ZigBee, Motor direction control, Rf modules module, USB module. Bluetooth. WIFI etc. Arduino microcontrollers are instructed and coded using the Arduino Integrated Development Environment. It works and supports efficiently in Windows, Mac OS X, and Linux operating system.

In our proposed method Arduino UNO Embedded Microcontroller is employed in three modules. sensor node is placed on the dustbin to sense dry and wet waste, when it becomes full it sends the signal to the Transmitter node. The second module is transmitter node After Receiving the signal from sensor node it updates details such as area and location in the common cloud IOT database. The third module is Vehicle module it is placed inside vehicle. The transmitter node sends the information to particular Location vehicle Driver to collect the waste.in the vehicle it has separate provision to collect dry and wet waste using conveyor belt and h-bridge motor driver circuit controlled by vehicle node. After collecting the waste, it updates the information to the common think speak cloud database system

#### Sensor Module:

The sensor node module consist of obstacle sensor and RF module. It is placed inside the dustbin when it becomes full it enables the RF module to transmit the signal to the Transmitter node.



**Block diagram of Sensor module** 

#### Vehicle Module:

In vehicle module We placed a conveyor belt on the dry and wet dustbins located in the common place. The Arduino Atmega 328 Microcontroller receives the input through the dust collecting labors to press the switch. By using the switch it sends the input signal to the at mega -8 Arduino embedded microcontroller then it sends the command to H-Bridge to rotate the conveyor belt to dump the waste inside the vehicle. After that the empty dustbins are placed in the common place. After completing the process it updates the information in the common think speak cloud database.



#### **Block diagram of Vehicle Module**

#### **III. HARDWARE DESCRIPTION & RESULTS**

1. Features of Atmel ATmega328

ATmega328 microcontroller operating at 5V. 2Kb of RAM, 32Kb of flash memory.

- 1 Kb of EEPROM for storing parameters. ٠
- The clock speed is 16 MHz.
- The board has 14 digital I/O pins
- 6 analog input pins

Microcontroller	ATmega168/328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage(limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DCCurrent per I/O Pin	40 mA
DCCurrent for 3.3VPin	50 mA
Fash Memory	16 KB(ATmega168) or 32 KB(ATmega328) of which 2 KB used by bootloader
SRAM	1 KB (ATmega168) or 2 KB (ATmega328)
⊞ <b>PROM</b>	512 bytes (ATmega168) or 1 KB (ATmega328)
Clock Speed	16 MHz

#### Fig shows the features of Atmega 328 Embedded microcontroller



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#### Fig Arudino Micro controller Hardware architecture

#### 2. LCD Display :-

- ≻ It Display messages
- 16x2, Consist 16 columns and 2 rows.

Letters of alphabet, special characters, punctuation marks, mathematical symbols etc.

Displays has built in backlight blue or green LED.

When used during operation, a resistor for limiting the current should be used with any LED.

The data is the ASCII value of the character to be  $\triangleright$ displayed on the LCD.

Disadvantage-contents will be lost upon the power  $\geq$ off.

It has three control lines such as Enable.read/write and register select

**Enable** (E) $\rightarrow$ Allows access to the display through R/W and RS lines. Low-LCD is disabled & ignores signals from R/W & RS.High-LCD checks the state of the 2 control lines & responds.

2.Read/Write (R/W) it Determines the direction of data between the LCD and microcontroller. Low-data is written to the LCD.High-data is read from the LCD.

Register select (RS) it interprets the type of data on data lines.

 $\rightarrow$ Low- an instruction is being written to the LCD.

 $\rightarrow$ High-a character is being written to the LCD.

#### 3. DC-Motor & H-bridge Driver IC :-

In this vehicle module we preferred DC motors having external gear arrangement attached with motor. These motors that are most commonly used in this module because they are have considerable torque to rotate the motor in clockwise and Anti-clock wise direction .we use a H-bridge motor driver circuit to lift and dump the waste inside the vehicle.

To control the DC motor motion operation of dry and wet waste separately . we use "Dual H-Bridge IC L293D" is employed in vehicle module.Only 4 possible switches can be used for DC motor rotation control, for clockwise rotation the position of switch S1-S4 ON, S2-S3 OFF, And for anti-clockwise rotation the position of switch S2-S3-ON, & S1-S4 OFF



#### Fig B direction control using switches



Fig D shows the rotation direction of dc motor





Fig a DC -Gear motor



Fig c H-bridge L2830 motor driver IC

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When both the inputs are low as well as high means DC motor will stop rotating, if first pin (4)output is high and second pin(5) output is low the DC motor will rotate in forward direction (Clockwise ). Next condition if first pin (4) output is low and second pin output is high(5) the DC

motor will rotate in reverse direction (anti - Clockwise). The table shows the direction control of DC motor based on the pin output. These pin configurations are coded inside the Arduino Microcontroller using Arduino IDE software.



Fig shows the interfacing DC motor and H- bridge to Atmega 328 microcontroller

#### 4. Think speak Cloud Database :-

The sensor node module is placed inside the dry and wet dustbins, it consist of a RF module transmitter, receiver, sensors and microcontroller when it becomes full it identifies using the object sensor and it transmits the signal to the Transmitter node. The second module is transmitter node After Receiving the signal from sensor node it updates details such as area and location in the common think speak cloud IOT database.





Figure: Vehicle Forward And Backward Movements



**Figure: Dry Collection Monitoring** 



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Figure: Wet Collection Monitoring

The third module is Vehicle module it is placed inside the vehicle. The transmitter node sends the information to particular Location vehicle Driver through the Android APP by commanding him to collect the waste in exact location. In that vehicle it has separate provision to collect dry and wet waste using conveyor belt and H-bridge motor driver circuit controlled by vehicle node. After collecting the waste, it updates and monitors the data in common think speak cloud database system. The graph analysis shows the frequent updating of waste data in the think speak cloud database.

#### **IV. CONCLUSION**

The proposed smart automation Technique to collect dry and wet waste using IOT module has practically working in efficient manner. whenever the waste is full in the dustbin situated in a common location in every area, it automatically passes the information to the transmitter module to collect waste from the particular location. The transmitter module will update the exact location and place of the waste in the think speak cloud database. And then the transmitter node passes the information to exact location vehicle driver through an android APP by commanding him to collect the waste. The vehicle has a provision to collect and dump separate dry and wet waste using conveyor belt and h-bridge motor driver circuit controlled by vehicle node. After collecting the waste in each and every area, it updates the information in think speak cloud Database. Using the think speak cloud database it can continuously monitor every location updates the details about waste collection. In day to day life in our surrounding environment the waste collection will increases or decreases it makes the think speak cloud system database to be updated frequently. The proposed method finally created a path to achieve our government 'SBM' Swach Bharat Mission to keep our surrounding to be clean.

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Authors: Poojari Yugendar, K. V. R. Ravishankar

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#### PREDICTION OF RECYCLED CONCRETE AGGREGATE SELF COMPACTING CONCRETE COMPRESSIVE STRENGTH USING MATHEMATICAL MODEL

Srinivas Vasam, K. Jagannadha Rao, M.V. Seshagiri Rao

Abstract

Sustainable Development aims at improving the standard of life without compromising the environmental qualities and for future needs. These objectives can be achieved through recycling of construction/demolished waste. In Paet, land filling of Construction and Demolished waste materials was the general solution. As raw Construction Material Charges have risen dramatically, we have to look for alternative solutions and methods, such as recycling of demolished waste.

Recycled Aggregate Concrete not only solves the problem of Construction and Demolition waste disposal, but also conserves the use of natural resources in effective manner to maintain ecological balance. Thus, Recycled Aggregate Concrete has become potential material of construction industry, and it requires all attention in terms of focused research to explore it fully.

In the present study, RCA was used as partial and full replacements of NA to produce self-consolidating concrete (SCC). Different SCC mixes were produced with RCA substituting 0%, 25%, 50%, 75%, and 100% NA by weight. The present study aims at developing a mathematical model / Empirical model/ Multiple Regression Analysis proposed to estimate to predict the compressive strength of NASCC & RASCC different grades of concrete with different proportions of RCA. The Empirical model developed resulted in predicting the compressive strength of SCC with Recycled Aggregate Concrete(RASCC) mixes with a maximum error of 10.9% which is within acceptable limit considering the heterogeneity of concrete mixtures and certain limitations of experimental work. Further, the present study has also established a close correlation between theoretical (predicted) and experimental values of compressive strength having correlation coefficient value of 0.9%.

Full Text: 

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## Mathematical Model for Prediction of Compressive Strength of Normal, Standard and High Strength SCC with RCA

Srinivas Vasam 🖾, K. Jaganadha Rao & M. V. Seshagiri Rao

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#### Abstract

Sustainable development aims at improving the standard of life without compromising the environmental qualities and for future needs. These objectives can be achieved through recycling of construction/demolished waste. In the past, landfilling of construction and demolished waste materials was the general solution. As raw construction material charges have risen dramatically and also natural resources are exhausting, alternative solutions and methods are to be thought of, such as recycling of demolished waste. In the present study, recycled concrete aggregate (RCA) was used as partial and full replacements of natural aggregates (NA) to produce self-compacting concrete (SCC). Different SCC mixes were





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