NATIONAL COMPITITION SPONSORED BY

OUTSTANDING YOUNG CHEMICAL ENGINEER AWARD 2020

Organised By

DEPARTMENT OF CHEMICAL ENGINEERING,MUMBAI

INSTITUTE OF CHEMICAL TECHNOLOGY, MUMBAI

IN ASSOCIATION WITH

INDIAN INSTITUTE OF CHEMICAL ENGINEERS

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INTRODUCTION

About (IIChE):

Indian Institute Of Chemical Engineers is a confluence of streams of professionals from academia, research institute and industry. It provides them the appropriate forum for joint endeavors, hand-in-hand, to work for human being through application of chemical engineering and allied sciences. If you are interested about, attached to or involved in chemical engineering related activities – whether as a student as a seasoned professional - you shall find the programme of IICHE immensely beneficial, opening up doors of new possibilities and existing possibilities

IIChE-MRC:

IIChE–MRC is one of the 33 regional centers of the Indian Institute of Chemical Engineers (IIChE), the apex of professional society of Chemical Engineers in India. The Mumbai Regional Center (MRC) is the biggest of the mall with nearly 13.3% of the total all India membership of almost 13250 engineers.

About ICT:

Institute of Chemical Technology was established on October 1,1933 as the UDCT–University Department of Chemical Technology of the University of Bombay(now Mumbai), with the noble intention of advancing India's knowledge reserves in chemical science and technology. The Institute has grown to become a premier(deemed) university devoted to education, training, research and industrial collaboration in chemical engineering, chemical technology, applied chemistry, pharmacy, biotechnology and bio-processing. The list of achievements of this great center of learning is voluminous and ever since its inception, the Institute has been offer tile breeding ground for some of India's most gifted minds. The Institute's alumni have distinguished themselves in all walks of life, be it in industry, academia, government or public service in India as well as abroad. Some of the rare international honors have been best owed upon the mind some have been role models, serving the nation.

About OYCE Awards:

Indian Institute of Chemical Engineers (IIChE) Mumbai Regional Center (MRC) introduced for the first time, an event known as Outstanding Young Chemical Engineers Award (OYCE) in the year 2005 to broaden the horizons of thought and its potential innovative candidacy of the developing crop of Chemical Engineers. The prizes for the competition have been sponsored by Blast Carboblocks/ thyssen krupp Industrial Solutions right from the inception of the event. After the immense success of the earlier ventures, IIChE-MRC is pleased to announce the 13th annual session of OYCE. The national event unfolds this year 2020 at Institute of Chemical Technology, Mumbai. The event comprises of Technical Paper Presentations.

IIChE–MRC is one of the 33 regional centers of the Indian Institute of Chemical Engineers (IIChE), the apex of professional society of Chemical Engineers in India. The Mumbai Regional Center (MRC) is the biggest of the mall with nearly 13.3% of the total all India membership of almost 13250 engineers.

Programme Schedule

Programme Description	Time
Registration	08:30 to 09:30
Inaugural Session	09:30 to 10:15
Hi Tea	10:15 to 11:00
Industry Session-1 / Undergraduate Session	11:00 to 13:00
Networking Lunch	13:00 to 14:00
Technical Talk	14:00 to 15:00
Industry Session-2 / Undergraduate Session 2	15:00 to 16:00
Hi Tea	16:00 to 17:00
Panel discussion	15:00 to 16:30
Award ceremony	19:00 to 20:30

❖ IIChE NATIONAL ADVISORY COMMETTIEE:

- Dr. G D Yadav (Emeritus Prof. of Eminence, ICT)
- Dr. Basava Rao (President IIChe, Osmania University)
- Shri. R G Rajan (Past Chaiman, IIChE-MRC)
- Shri. Praveen Saxena (Vice-President IIChE)
- Shri. VK Shrivastav (Past President, IIChE-MRC)
- Dr. Sanjeev Katti (Director General ,ONGCEC)
- Shri. P D Samudra (MD & CEO, thyssenkrupp Industrial Solutions India)
- S.K. Nayak (Director Technical Heavy Water Board)
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- Shri. Manoj Kharkar (VP Reliance R&D Centre)
- Shri. Arunkumar Saxena (Chairman, Blast Carboblocks Pvt. Ltd.)
- Dr. Ashwin Patwardhan (HOD- CheED, ICT, Mumbai)
- Shri. Rakesh Mehra (Retd. Director BPCL)

❖ ORAGANISING COMMITTEE:

- **Chairman** : Dr. U Kamachi Mudali, Chairman, IIChE-MRC & CE, HWB
- **Co-Chairman**: Dr. A B Pandit (Vice-Chancellor ICT, Mumbai)
- **Convener**: Dr. Parag Gogate (Prof. Che ED ICT, Mumbai)
- **Co-Convener**: Dhawal Saxena (Jt. Sec. IIChe- MRC, & AD, BCPL)
- **Co-ordinator**: Smt. Satyashwini S (SO/E, HWB)

❖ MEMBERS:

- Dr. Anand Patwardhan (Prof. ICT)
- Dr. Bhagwat (Prof. ICT, Past Chairman IIChE MRC)
- Dr. Rathod (Prof. ICT)
- Dr. Mariam Deghani, Professor.
- Mr. Nikhil Nilange (Project & Product Development, BCPL)

CHIEF GUEST'S MESSAGE

DR. U KAMACHI MUDALI

Chairman

Executive Committee, IIChE-MRC

Mumbai Regional Center of Indian Institute of Chemical Engineers initiated a competition known as “Outstanding Young Chemical Engineer Award” in 2005. The prizes were sponsored by M/s Blast Carboblocks and M/s Thyssenkrupp Industrial Solutions. It gives me immense pleasure to announce that the 13 th Outstanding Young Chemical Engineer Award in association with Institute of Chemical Technology, Mumbai was held on 15 th February 2020 and successfully executed.

The association of Mumbai Regional Center of Indian Institute of Chemical Engineers (IIChE-MRC) with Institute of Chemical Technology has been quite long, pleasant and mutually rewarding. This amalgamation has proven very fruitful to the future generations. I am happy that the competition attracted many undergraduate level participants in and around Mumbai along with the industrial presence with many participants showcasing their research and process or product developments.

The papers presented in both categories highlighted their hard work, farsightedness and passion towards contributing to the present chemical engineering problems in the industry. I congratulate the organizing committee as well as the participants for making this programme a grand success.

Dr. U Kamachi Mudali
Chairman
Executive Committee, IIChE-MRC
Chairman & CE, Heavy Water Board

VINAYAK MARATHE

Sr. Vice President, R & D, Reliance Industries Limited

India is on the growth path, India's GDP is growing at the rate of 6-7%. India is aiming for 5 trillion dollar economy by 2024. For India to achieve the target of 5 trillion dollar economy both service and manufacturing sectors have to grow. India has the youngest population in the world and also the highest number of professionally qualified people in the world.

It took more than 250 years for first three industrial revolutions, however 4th industrial revolution is happening with lightning speed. It is not only changing the nature of business but creating the disruptions. Plastic pollution and global warming are the issues on the forefront for every country to tackle. Emergence of Shale gas in the last decade, Emergency of electric vehicle, emergence of hydrogen economy, various innovations on renewable energy, new technologies to make bio-fuels etc are going to dominate the future of industry. AI, robotics, machine learning, virtual reality etc are going to improve the productivity of existing business. Next industrial revolution will be convergence of Physical, Digital, and Biological worlds.

In this VUCA (Volatile, Uncertain, Complex and Ambiguous) world, young engineers will be required to quickly adopt the new skills to remain relevant for 30-40 years of their career. Traditional manufacturing or engineering services job for engineers will fast deplete in years to come. Outstanding Chemical engineer will be the one who can adopt new skills in his/her core field, who can acquire specialization in the technologies which can change the world, who can quickly unlearn and learn, who can work with entrepreneur mindset, and who can quickly adopt the change.

IIChE initiative to reward Outstanding Young Chemical Engineers is highly appreciated. This initiative has provided a platform for young engineers to exhibit their talent and also receive valuable feedback from the experts in the field. I am sure all engineers who participated in the event have got the great insight to achieve many rewards in their career.

THOMAS MATHEW

Sr. President, Reliance Industries Limited.

I am very happy and privileged to be involved in my capacity as a judge for the "Outstanding Young Chemical Engineers Award OYCE -2020" competition held in ICT on 15th February, 2020 and awards thereof. It is a remarkable event initiated to encourage and motivate young Chemical Engineers to undertake and execute innovative projects for either solving a problem in Chemical Process or developing a breakthrough technology for the benefit of entrepreneurs who can make use of it.

The papers presented by young undergraduates who were in their sixth Semester or below, where of the quality expected of them. As per me, those who participated were of high calibre and is expected to do well in their academics and future career. The projects undertaken by the professional Chemical Engineers were really of excellent quality and merit. Most of them were developed to solve existing problems and in a few cases for extra value creation by developing new process.

The conference was organized well. I complement the organizers and ICT authorities who extended full co-operation for the conference. I enjoyed my interaction with the Chemical Engineering fraternity and the young undergraduates. I will be happy to be associated, in some way for such future initiatives.

Prof. ANIRUDDHA B PANDIT

Vice-Chancellor, Institute of Chemical Technology, Mumbai.

Dear All, I was delighted to attend the OYCE and was very happy to experience the enthusiasm with the participants contributed to the event. I was very fortunate to be a part of this event. The breadth and the width of the topics covered in the competition clearly indicated the global thinking of Chemical Engineering community. We all should feel proud of this fact.

OYCE has become a regular feature in the chemical engineering calendar of the IIChE, MRC and the members have started looking forward to it.

I would also like to compliment the overwhelming response of the Working Professionals and their involvement must have taught the young UG's and PG's the virtues of continued practice of Chemical Engineering principles. Everywhere the issues start with Material and Energy balance to quantify the problem and also the solution.

The topics covered and presented had a correct mix of traditional and upcoming areas and this also showed the time lag between the Academic Institutes and their Industrial counterparts. Let us make an attempt to reduce this time lag and pledge ourselves that we will be the first to try and experiment with the innovation and Chemical Engineering community be recognized as the most innovative engineering community.

My sincere Best wishes to the team and let it be scaled up further.

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The Company follows Quality Standards in manufacturing. The business aim is to follow a safety system and adhere to the responsible care program and most of all provide customer satisfaction. For this purpose, the Company has acquired necessary Licences and Permissions from various Government Agencies to set the pharmaceutical and industrial standards in the Company's activities. The Company also has a Quality Management System and are certified ISO 9001:2015 by Stancert Assessors Pvt. Ltd. and accredited by DAC for Manufacture and Supply Of Bulk Drug Intermediates, Chemicals and Auxiliaries. The Company's strength remains in complete secrecy of manufacturing process and personal attention to it. This results in getting the right quality and maximum yield.

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360 DEGREE VIRTUAL TOURS FOR CHEMICAL INDUSTRIES BY
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Bridging the gap between perception & positioning through virtual reality

If a picture is worth thousand words, then a 360-degree picture is probably worth a million words. Stich all the 360 pictures of a facility into a virtual tour and you get an entire thesaurus.

Visualization and virtual reality have become an integral part of the modern-day world. The advent & rise in remote connectivity has also increased the premium on ones' time.

No one wants to invest time for nothing. Whether its travel, eating out, shopping or selection of college campus, people like doing online research to determine whether a place is worthy of paying a visit. The same holds true for industry. Whether it's a new customer trying to decide whether the

factory is worth visiting, or the directors of the company wanting to monitor progress of construction or whether it's the auditor checking the EHS compliance, or the sales team trying to showcase production capacity to a new client at his office or in a trade show, virtual tours provide a great tool for a remote preliminary evaluation & appreciation of the facility.

What is a virtual tour?

360 degree virtual tours are the next best thing to a physical premises visit. In a virtual tour, one can move around a campus or a facility in virtual reality. A virtual tour is made by taking 360 degree pictures of different areas of a facility through different vantage points and then stitching them together in such a way that you can move from point to point, just as you would take steps in a physical facility, and turn around to look at every nook & corner of the premises.

Virtual tours can be accessed through laptop computers, tablets or phones. For more realistic experience one can also use Virtual Reality glasses. Virtual tours can be uploaded on websites, can be shared online through email or WhatsApp or simply copied in laptops/ phones.

How is Virtual tour different from still pictures or videos?

In a still picture one can only view a single preset frame. In a video while there are multiple frames, but what the viewer sees and for how long, is determined by the videographer. In 360 degree virtual tour, the viewer has the choice to move to multiple points within the premises by clicking on the navigational arrows on the screen, get an all-round 360 degree view at each point by moving the screen with mouse or his finger and zoom in & out and observe a frame for as long as he wishes. The virtual tour can also be visualized through Virtual Reality glasses that makes a person feel as if he is standing within the facility.

Use cases of 360-degree virtual tours for chemical industry

Internal Audit

Construction or expansion of production facility is a complex process. Typically, there are recommendations / corrective measures suggested by the senior management & in-house auditors during construction and commissioning. A 360 virtual tour can capture in detail, the status of factory pre and post commissioning. A Virtual tour provides a great comparative tool for the senior management, directors & other stakeholders to remotely apprise themselves of the progress at different stages and verify the compliance of best practices during commissioning.

Marketing & Sales

With a virtual tour, your sales team can virtually carry your entire factory in their laptop to the client's office. More often than not, clients like to make a factory visit to apprise themselves of the production capacity & capability. Although there cannot be an alternative for a physical facility visit, 360-degree virtual tours are the next best thing to remotely provide an experiential tour of the facility in virtual reality. It goes without saying that a good first impression created through a 360-

degree virtual tour inspires confidence in the client that his efforts to visit the factory will not be in vain. This leads to expedition of due diligence process and signing of contracts. Apart from the sales calls, virtual tours can be used to the same effect in off site trade shows. Virtual tours can also be uploaded on the company websites and shared with stakeholders as links through email and Whatsapp.

EHS Compliance documentation & record keeping of other best practices

Virtual tours can go a long way in documenting your environment, health & safety measures and also create a good showcase of your best practices to clients, authorities, directors & other stake holders. A virtual tour recorded at different stages of compliance & commissioning is a great visual compliment to the as built drawings and manuals. You can proudly let the stakeholders know how serious and diligent you are regarding the safety & best practices implementation in your facility.

Corporate Training & Induction

360 virtual tours of the factory are a cost effective way of training the shop floor as well as the support & business functions staff regarding the shop floor operations and best suites of the company. An immersive tour can remotely give the experience of being in the facility to the trainees. This can save a lot in cost, especially for team members who are not directly involved in the shop floor operations but needs to be given an overall orientation about the production facility & process.

About Customised360 Virtual Tours

Customised 360 (https://customised360.com) is a starburst from Customisedhomes.com, a AR / VR visualization based home improvement startup founded by Mr. Hitesh Ahuja , an alumnus of NIT Bhopal and prestigious Indian School of Business (ISB) Hyderabad , and Mr. Sukesh Ahuja an Engineer from Mumbai University and University of Birmingham (U.K.)

We have taken our visualization tech and platform developed for customisedhomes.com to industry wide use cases such as real estate, retail, hospitality, tourism, education and Manufacturing. With diversified team of MBAs, designers, photographers & visualizers, our endeavour is to harness the power of virtual reality to create enhanced experiences for customers of our clients. Customised360 virtual tours are customized to your needs have a lot of information & tools built into the tours as per your needs. For more details please contact us at:

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ABSTRACTS

- **Under Graduate Category**
- **Working Officials Category**

Under Graduate Category

ENVIRONMENTALLY SUSTAINABLE DESALINATION USING TEMPRETURE SWING SOLVENT EXTRACTION

Mr. Prashil Badwaik

(VNIT, Department of Chemical engineering)

Abstract:

India is facing its worst-ever water crisis in its history with 13th rank among 17 worst- affected countries, according to the report given by the World Resource Institute.

Currently, 600 million people in India face high to severe water stress and about 2 lakh people die every year due to inadequate access to clean water. By 2030, the water demand of the country is projected to be twice the available water supply, implying severe water scarcity and nearly 40% of the population will have absolutely no access to drinking water. So, more research is going on the desalination. There are many techniques available for the desalination such as membrane distillation, reverse osmosis, evaporation-based thermal methods, etc. However, the hypersaline water obtained from these processes are of growing environmental concern. This hypersaline water is still having the large amount of water, which is not suitable for crystallization which will be expensive or evaporation-thermal based method where enthalpy of vaporization for water is huge ≈630 kWh/m3, thus thermally constrained. Therefore, there is need to develop an energy efficient method for the more sustainable desalination of hypersaline streams.

Temperature swing solvent extraction (TSSE) is a radically different desalination technology that is membrane-less and not based on evaporative phase change. TSSE utilizes low temperature heat and a low-polarity solvent with temperature-dependent water solubility for the selective extraction of water over salt from saline feeds. This study demonstrates TSSE desalination of high-salinity brines simulated by NaCl solutions with three different amine solvents. It is shown that using TSSE we can treat the water with salinities as high as ≈234000 ppm total dissolved solids (i.e., 4.0 M NaCl) and achieve salt removals up to 98.4%. Performance of solvents is checked based on water extraction efficiency, product water with the lowest salt content and solvent loss. Lastly, a high water recovery of >50% was demonstrated for TSSE desalination. This study underscores the unique capabilities of TSSE for the desalination of hypersaline brines.

Keywords: Desalination, Solvent extraction, sustainability.

ENERGY SAVING OPPORTUNITIES USING HEAT

Hasan Shahid, Prithveeraj Wavre , Vignesh Vishwanathan

(Thadomal Shahani Engineering College-Mumbai)

Abstract:

Today the Energy industry is the largest industry in the world with an evaluation of about 6.5Trillion dollars. Our energy consumption is about 18 Terawatt Hour (TWh) per year. According to the International Energy Agency our energy consumption is going to increase by 40% by midcentury. This high energy consumption is going to be driven by the developing nations like India and China as the GDP per capita is proportional to energy consumption per capita. If developing nations start consuming at the standards of developed nations, our energy consumption will rise up to 100TWh per year. This high energy consumption and the depleting energy sources make it our prime responsibility to shift to renewable sources and use energy efficient methods. In our project we are going to emphasize upon the energy efficiency aspect using Heat Pumps. Heat pumps offer an energy-efficient alternative to furnaces and air conditioners. Like your refrigerator, heat pumps use electricity to move heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. During the heating season, heat pumps move heat from the cool outdoors into your warm house and during the cold season, heat pumps move heat from your cool house into the warm outdoors. Because they move heat rather than generate heat, heat pumps can provide equivalent space conditioning at as little as one quarter of the cost of operating conventional heating or cooling appliances. Heat pumps have wide applications in the chemical industry as well. They can be used in industry for pasteurization, drying operations, washing processes and our most loved distillation columns.

HORIZONTAL DISTILLATION COLUMN

Mr. Ajinkya Sawant, Harshda Chawan, Aovi Deshpande

(Shivajirao S. Jondhale College of Engineering)

Abstract:

Vertical tray columns are widely used in refineries and other chemical plants to carry out separation of volatile mixtures by use of unit operations like distillation, gas absorption etc.

Almost every chemical industry/plant uses vertical distillation column which is very common for food and beverage industries. It is much more advantageous than the conventional vertical column. The higher pressure drop throughout the vertical column provides greater challenge for the separation of lighter component feed mixture.

The advantages of the horizontal distillation column are that it provides low pressure drop for the prevention of decomposition of heat sensitive material.

The entire shell has vapour liquid contacting thereby providing maximum surface area for mass transfer. Reflux is obtained by external cooling on the top surface of the shell. The cost of such equipment is low as compared to conventional vertical distillation column.

This column is designed for the separation of binary mixtures which is suitable for small scale industries.

The construction details for this particular distillation column are as follow:

This column has a partial condenser at the top and the reboiler at the bottom. Reflux is sprayed from the top.

The rotating tray arrangement is shaft driven which facilitates both gravitational and centrifugal contacting between the vapour and liquid phase. The rpm of rotating trays and the reactivity of handling feed is the deciding factor for uniform contacting.

The direction of the vapour is upward and design is pretty similar to a boiler drum. Mixture from the reboiler is mixed with preheated feed mix in column to reduce the reboiler duty.

INTELLECTUAL REVERSE OSMOSIS (I.R.O.)

Mr. Kuldeep Anandrao Yele

(MGM College of Engineering & Technology Kamothe, Navim)

Abstract:

We all are aware of Reverse Osmosis (R.O.) - a Membrane based Filtration Process. So in this era of technological development, in which humans are constantly struggling to get excellent and desired outcome. So basically in reverse osmosis all the impurities get filtered off and we get pure permeate. But in Intellectual Reverse Osmosis the separation of the impurities will be completely as per the user requirement.

Intellectual Reverse Osmosis is artificial intelligence based Filtration Process. In conventional process of Reverse Osmosis all the parameters are always constant as specifications of membrane will always be invariable. But in I.R.O. a user can set the parameters according to his needs and he is capable of changing the Concentration of specific impurity from the feed.

I.R.O is made up of two parts, the scanning Sensor and the Intellectual Membrane. The sensor will scan the impurities present in the feed and examine the size and concentration of molecules present and send a signal to the membrane, then the membrane will adjust its pore size according to the size of impurities which is to be filtered from the solution.

Let's try to understand working of I.R.O by a simple example:

Consider a feed of water solution in which salt and sugar are dissolved. If we pass this solution in conventional Reverse Osmosis it will filter all the sugar and salt present in it and we will get only water as the permeate.

But in I.R.O, firstly sensor will scan the feed and examine the size and concentration of water, salt and sugar molecules present then if we want only salt should be filtered then we can set parameters that only sugar and water molecules will be passed through the membrane leaving salt behind. Also we can control the amount or concentration of salt should be filtered.

PROCESS INTENSIFICATION OF SESAME OIL EXTRACTION

Mr. Shirley Sanjay Kokane

(Pharmaceutical Sciences and Technology, ICT Mumbai.)

Abstract:

Sesame oil widely consumed as a nutritious food, very beneficial to health as a cooking oil because of its high smoke points. Sesame seeds are primarily produced in developing countries, a factor that has played a role in limiting the creation of large scale, fully automated oil extraction and processing techniques. Traditionally, sesame oil is often extracted with less expensive and manually intensive techniques such as hot water flotation, bridge process, the ghani process, or by using a small-scale expeller press, large scale oil extraction machines, or by pressing followed by chemical solvent extraction. In recent years, Defatting/extraction has been performed by various methods such as soxhlet extraction, supercritical fluid extraction, enzyme assisted aqueous extraction and hydraulic pressing. However, all these processes require longer time for processing (6-8 hours), the solvent: solid content ratio is also very high (~25:1), the improvement of yield and quality of the extracts. Apart from that, additional steps of free fatty acid removal, degumming etc. leads to rise in losses after every step.

Free fatty acids (FFAs) have long been recognized as a potential mediator of insulin sensitivity, secretion, and hepatic glucose regulation in obesity. Chemical refining is the traditional method used in past centuries for the separation of free fatty acids. The main purpose of chemical refining is to saponify the FFA by an alkaline solution and dilute the resulting soaps in a water phase. These soaps are removed by separators. Hence, we propose a concise method for both extraction of oil from the seeds along with its separation from free fatty acids. Ultrasound assisted extraction can be used with appropriate solvent to solid ratio for efficient extraction of sesame oil. When solid–liquid extraction is assisted by ultrasounds the possible benefits of their application in extraction are an intensified mass transfer, improvement in solvent penetration into the seeds and capillary effects. All of these effects make an easier access of the solvent to the tissues of the seed. The collapse of cavitation bubbles near the cell walls is expected to produce the cell disruption together with a good penetration of the solvent into the cells, through the ultrasonic jet. Solvent being used plays an important role, leading to a definite layer formation of the content in the mixture according to the miscibility and density. These immiscible layers can be separated effectively and hence can ease the separation of oil from the impurities. Therefore, an effective method can be implemented for extraction of oil having more efficiency also consuming less time and energy.

APPLICATION OF NATURAL FIBRE IN RUBBER

Dr. Bharat Kapgate, Dr. Sonali Dhokpande, Gandhar Nimkar, Anushka Sagar, Aadarsh shirsat

(1.Indian Rubber Manufacture Research Association, Thane. Mumbai. Maharashtra.

2. Chemical Engg. Department. Datta Meghe College of Engg. Airoli. Navi Mumbai.)

Abstract:

Natural fibre-based composites are under intensive study due to their eco-friendly nature and peculiar properties. The advantage of natural fibres are their continuous supply, easy and safe handling and biodegradable nature. Natural fibres are rapidly replacing carbon black due to their low costs, abundant availability, biodegradability and easy extraction. They have properties that are acceptable for the role of reinforces and have enhanced energy recovery. Another important reason for their selection is their carbon dioxide neutrality which makes them attractive in the present scenario of energy conservation and environment friendly alternatives requirement. A detailed study of chemical, physical and mechanical properties will bring out logical and reasonable utilization of natural fibres for various applications. In this review, a detailed study on the applications of some fibres, such as sisal, coir, etc. in rubber compounds, among others, have been studied. Moreover, it was observed that treated natural fibres can be added to rubber to improve or modify certain properties, such as green strength, creep resistance, hardness, aging resistance, dynamic mechanical properties, dimensional stability during fabrication, and real- time service, and to reduce the cost of fabricated articles. Authors have attempted to cover the basic information on natural fibres and their sources and also compared the physical, chemical and mechanical properties of various fibres from different sources. Furthermore, it summarizes the fibre reinforced polymer composites with their potential applications and future scope.

ULTRASOUND ASSISTED TiO2 SYNTHESIS AND OPTIMIZATION OF PHOTOCATALYTIC PERFORMANCE FOR DESULFURIZATION OF THIOPHENE

Mr.Ashlesha Tiple

(Institute of Chemical Technology, Mumbai)

Abstract:

Present work deals with ultrasound assisted synthesis of photocatalyst (TiO2) and evaluation of catalytic activity in presence of ultrasound, UV and oxidant for desulfurization of thiophene. The effect of different parameters such as the ultrasound power, irradiation time and quantity of structure directing agent CTAB on particle size was investigated. It was observed that the catalyst synthesized by ultrasound assisted approach under optimized conditions of 110 W power, 45 min of irradiation time and 0.091 g of CTAB gave the best particle size of 221 nm. A comparative study of Ultrasound assisted TiO2 and conventionally prepared TiO2 has been established successfully based on particle size. The prepared photo catalyst were characterized using SEM, XRD and FTIR Spectra. The catalytic performance of TiO2 was examined for desulfurization of simulated model fuel containing thiophene as model sulphur compound in presence of ultrasound irradiation and ultraviolet light. The influence of various parameters such as CTAB loading (0.0521 g - 0.0911 g), temperature (40 ºC - 80 ºC), TiO2 loading (0.25 g/L - 2 g/L) and H2O2 loading (5mL/L - 15 mL/L) on the extent of desulfurization of thiophene has been evaluated. 100% desulfurization was observed at optimized process conditions as 0.00911 CTAB loading, 60ºC temperature, 1 g/L TiO2 loading and 12.5 mL/L H2O2 loading. Complete removal of 200 ppm thiophene was achieved in 60 min of reaction time

MODELING OF HEAT TRANSFER IN ABANDONED OIL AND GAS WELLS

Mr.Arjav Utpal Shah

(Senior Undergraduate, Department of Chemical Engineering Indian Institute of Technology Bombay)

Abstract:

As the demand for energy continues to grow with the population in emerging countries, the use of alternative renewable sources of energy is imperative for the near future. The impending climate change and current economic development have forced a shift to more sustainable sources of energy like geothermal, solar, and wind. The widening of the supply-demand gap over the years has led to a global energy crisis and resulted in exhaustive use of non-renewable natural resources to meet the energy demands. This extensive use of fossil fuels has been made possible by the current development of human civilization. However, burning of fossil fuels, which are becoming increasingly scarce, has led to an increase in emissions of carbon dioxide, which is greenhouse gas, into the atmosphere. This, in turn, has also led to a detrimental impact on the environment and an imbalance in the natural ecosystem. Geothermal energy is a green, environment-friendly, low carbon, renewable and sustainable source of energy since there are relatively less investments and is pollutant-free. The major advantage of geothermal energy over other sources of renewable energy is that the underground heat energy mining does not depend on the weather conditions and geothermal power runs at much higher load factor than wind or solar. Nearly 40% of the total investment cost that goes into setting up a geothermal plant is the drilling cost. However, this problem can be potentially tackled by utilizing the currently decommissioned and abandoned oil and gas wells for geothermal purposes. Retrofitting an abandoned well to produce geothermal energy also saves the cost of exploring sites for geothermal fields. The estimated potential for the geothermal energy that can be harnessed in India is about 10 million kW. In this study, abandoned oil and gas wells have been simulated as a source of geothermal power to generate electricity. Simulations have been performed using COMSOL Metaphysics 5.2by coupling thermal reservoir with bore well heat transfer and laminar flow model. Water, which is chosen as the working fluid, is circulated down through the annulus and extracted back through the shorter insulated inner pipe. A parametric study to assess the production temperature using the finite element method with various operating parameters such as injection mass flow rate, re-injection temperature, well depth and geothermal gradient is performed. The results of this1study indicate that heat extraction rate increases with increasing mass flow rate as well as the well depth while all other injection parameters remain constant. At higher injection temperature, the net heat extraction rate from the reservoir decreases with time due to lower temperature difference between injected fluid and reservoir formation temperature.

SPECTROPHOTOMETRIC DETERMINATION OF FLOURIDE IN DRINKING WATER AND TOOTHPASTE

Aashish Jaiswal, Radha Sawant, Arpita Ghosh

(Thadomal Shahani Engineering College, Bandra, Mumbai)

Abstract:

Fluorides which are naturally found in soil, water, and foods, play a role of mineralization of our bones and prevent dental decay. Traces of fluorides are present in many waters but higher concentration are often associated with underground sources or by industrial effluents.

When present in lower concentrations in drinking water it has beneficial effects on teeth and bones, but excessive exposure to fluoride in drinking-water, or in combination with exposure to fluoride from other sources, can give rise to a number of adverse effects on reproductive organs, nerve and muscle and dental and skeletal fluorosis.

Based on scientific results it is found that drinking groundwater from sources such as bore-wells and hand-pumps in several states of India is contaminated with fluorides beyond the permissible limit of 1 – 1.5 ppm. 17 out of 32 states in India are reported to have endemic fluorosis.

Spectrophotometric methods are widely used for the determination of fluoride.

The method is based upon the reaction between fluoride ions and the coloured complex of Fe(III) with methyl salicylate to form the stable, colourless hexaflouride complex of iron.

The conditions of the method (pH, time and combination ratio) were studied and a standard curve was obtained for 0.01–0.08 mg NaF ml−1, at 525 nm. A study was conducted on interference with complexing anions of Fe (III), cations that react with fluoride ions and with common ingredients of dosage forms and dental preparations.

The method was validated and the results showed good precision (100.16 ± 2.33%) comparable with that of other analytical methods. Good results were obtained in the spectrophotometric determination of fluoride ions in a water and in a toothpaste.

This paper moreover reviews the human health effects of fluoride as well as the methods used for determination of fluoride content. It also suggests potential ways to reduce the hazardous ingestion of fluorides through the regularly used toothpaste and water.

Various other research papers in the concerning field, articles and journals, self examination by performance of the experiments and the knowledge gained through the Engineering Chemistry course have also been significant contributors to this paper.

NANO - CELLULOSE

Mr. Salil Modak

Abstract:

Plastic is one of the best chemical engineering wonders till date as it can be used anywhere and everywhere, it has many exciting properties which are useful for us in different situations. Around 40-45% plastic produced, is used in packaging. But the main setback of plastic is that if not recycled or reused it just persists in the environment for centuries. So, why to use a material which lasts almost forever to just protect a product which lasts merely for days. Hence the alternative of plastic should be strong and as well as biodegradable.

Here with the help of nanotechnology we can produce Nano sized cellulose fibrils, arranged in such a way to form a tightly packed structure which is as strong as plastic and biodegradable as well. This is called Nano-Cellulose. Just a very thin layer of this Nano material is enough for the safety of the product. Nano-cellulose is so tightly packed that even a single oxygen molecule cannot penetrate through it and which is the most important thing while using it in packaging of food products.

The most important function of food packaging is to maintain the quality and safety of food products during storage and transportation. So it is important to have maximum shelf life of food products and prevent any spoilage due to unfavourable factors like chemical contaminants, moisture, oxygen, and exposure to light. The packaging materials should provide physical protection and maintain the food quality from the time of processing till it reaches the consumer.

Traditionally materials based on glass, aluminium, tin, synthetic plastics are used in the packaging industry. These materials have great barrier properties but are of great disadvantage from environmental point of view. Nano cellulose also has all of these properties - edibility, flexibility, transparency, antimicrobial but most importantly biodegradability which proves its robustness.

Cellulosic nanomaterial's have the capacity to form hydrogen bonds that allow the material to create a dense network, which hinders various molecules from passing through. This is a vital factor in the packaging industry. Nano cellulose's properties enable the development of new materials and the improvement of conventional materials. They form four forms of barrier properties which are important in various applications of Nano cellulose in packaging, namely

1. Oxygen Barrier
2. Oils, Grease Barrier
3. Water Vapour Barrier
4. Aqueous Liquid Barrier

Nanoparticles from cellulose and starch are even more rapidly biodegradable than their macroscopic counterparts. Large amount of our packaging material ends up in landfills or roadside litter, we can expect its increasing quantities in the future to be recycled into useful products. Hence Nano cellulose can be incorporated into packaging products as an alternative to plastics to help reduce the pollution caused due to plastic.

Key Words: Nano cellulose, Biodegradable, Food Packaging.

INTENSIFICATION OF HYDROGEN GENERATION IN WATER SPLITTING REACTION USING ALUMINUM IN PRESENCE OF GALLIUM

Gaurav Jadhav, Sunny Kalekar, Shyam P.Tekade

(Department of Chemical Engineering, Gharda Institute of Technology, Lavel, Khed, Maharashtra, India- 415708)

Abstract:

Present study focuses on the in-situ/on-demand generation of hydrogen gas through water splitting reaction using waste aluminium. The waste aluminium obtained from waste soft drink cans of 0.097 mm thick was utilized as the source of aluminum. The use of room temperature liquid metal gallium was evaluated as the activator for aluminum metal under alkaline conditions. Hydrogen generation has been parametrically studied at various concentrations and temperatures of alkali. The gallium proportion of 99% by weight of the total weight of metal and the low concentrations of alkali, sodium hydroxide of 0.1 - 0.5 N concentrations has been evaluated at the temperatures of 50, 60 and 70 ^{o}C. The complete conversion of aluminum was reported and the gallium was observed to intensify the rate of hydrogen generation as compare to the hydrogen generation in absence of gallium. The experimental data has been treated using Shrinking Core Model and the possible rate controlling mechanisms has been discussed. The added gallium was separated after the reaction.

Working Officials Category

ADDITION OF NITRIC ACID IN NEUTRALIZER REACTOR IN COMPLEX FERTILIZER PLANT AT TROMBAY

Mr. Vidyanand Ramchandra Kudtarkar

Manager (Chemical)

Abstract:

In RCF, Complex Fertilizer grade (NPK 15:15:15) is manufactured and marketed under the brand name “SUPHALA”. The process Licensor is “KEMIRA”, Finland with Phosphonitric Process using three reactor system.

The Rated capacity of this plant is 1500 MTPD. Main raw materials are Gaseous Ammonia 60% Nitric Acid, Rock Phosphate, KCl and Mono or Di- Ammonium Phosphate.

Process Description:

The first Reactor is a Digester where Rock Phosphate reacts with 60% Nitric Acid to produce mainly Calcium Nitrate and Phosphoric Acid.

Main Reaction: Ca3 (PO4)2 +6HNO3 + H2O □ 3Ca (NO3)2+ 2H3PO4 + H2O (exothermic reaction). Excess Nitric Acid is used to adjust the grade of product as per FCO Norms.

Second & Third reactors are Neutralizers. In Second Reactor this acidic slurry is partially neutralized with Gaseous Ammonia. MAP is also added here.

The slurry thus formed is further neutralized in Third reactor with gaseous Ammonia at a temperature of 120-1250C having moisture in the range of 8-10%.

This final slurry is granulated in a rotating drum called Spherodizer with atomization of hot air. The granules formed in Spherodiser are cooled, coated with Anticaking agent and then bagged in Bagging Plant.

Vapor Handling System: Waste gases from the reactors mainly contain Water vapor along with NOx, Ammonia & some fine dusts of Solid raw materials are scrubbed in a three stage system. Fresh water is used in first scrubber and acidic water is used in other two. Weak Sulphuric Acid (68%) was used for scrubbing (2M3/Hr) in other two to control Ammonia emission.

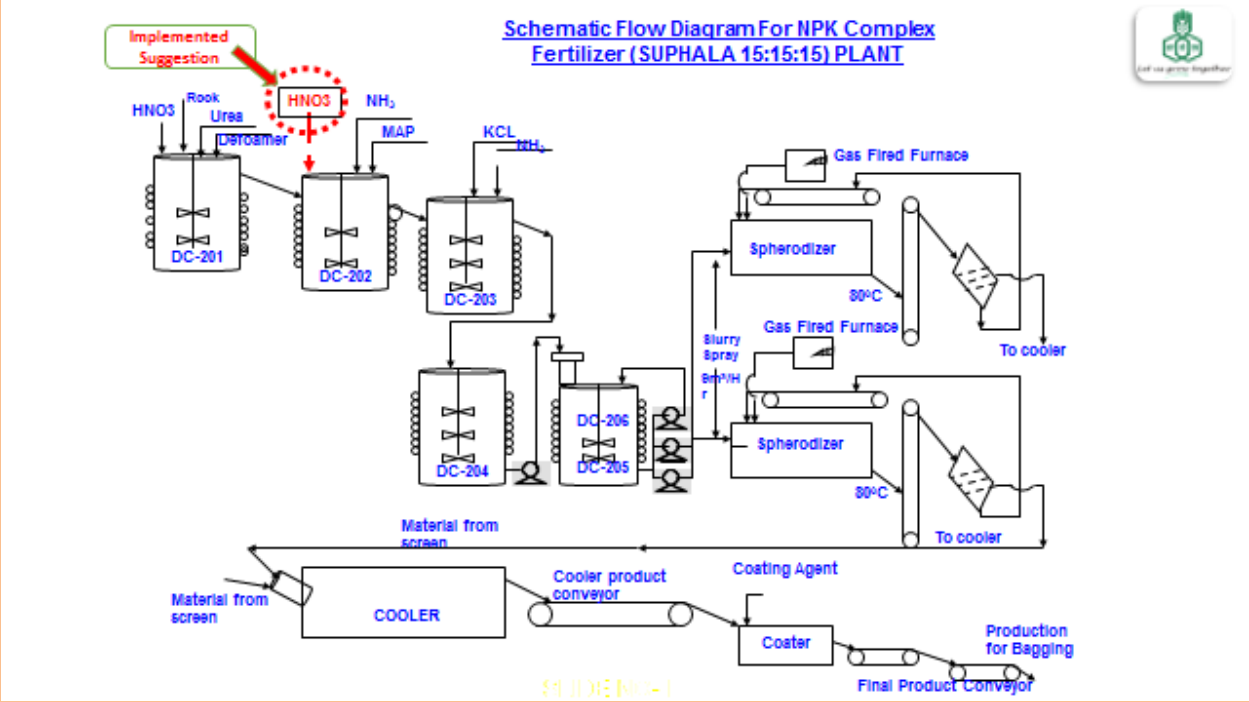
Findings from Study:

The Stoichiometry of reaction in First Reactor was studied and found that Nitric acid was being dosed in the ratio of 1.35w/w (against required 1.2w/w). Remaining quantity was added in first reactor to achieve final grade of the fertilizer product as per FCO Norms.

Also it was observed that emission level of NOx (1-1.5%) from First reactor and Ammonia emissions from second reactor (1.5 -2 %) was much higher.

Implemented Suggestion:

Hence it was suggested to add excess quantity (0.15 w/w) of Nitric acid into Second Reactor instead of first reactor. Suggestion was implemented on 05th November 2019.Nitric acids being added in second reactor with a sparger near the vapor outlet duct.



Benefits:

After this modification, Ammonia emission from second reactor reduced from (1.5 – 2%) to (0.8 – 1.2%). This in turn reduced the quantity of scrubbing acid required in the scrubbing section. Also NOX emission from First Reactor is minimized.

Tangible Benefit we derived is:

1. Saved in Ammonia Emission from Reactors as specific consumption of Ammonia reduced from 0.095 to 0.091 Kg/MT. i.e. (0.04* 5, 50,000(Annual Production)*23000/1000) Rs.5, 06,000 is saved per annum.

2. Saved loss of Sulphuric Acid in Scrubbing Section: (2(Consumption)*1.5(Sp.gravity) *0.68(Concentration)*24*300*1400(Cost of Sulphuric Acid)) Rs. 2,05,63,200 per annum.

3. Saved In Effluent Treatment Cost: 2*24*300*120 = Rs 17,28,000 per annum

CHEMICAL PROCESS SIMULATION USING OPEN MODELIICA AND DWSIM

Mr. Priyam Nayar

(FOSSEE, Department of Chemical Engineering, IIT Bombay)

Abstract:

An attempt has been made to develop a process simulation environment that can perform steady and dynamic simulations. The work reported through this paper has been made free and open-source to benefit the small and medium scale chemical industries who can utilize such simulation environment to perform material and energy balance which can be utilized in optimizing the energy and cost requirement in the plant.

Detailed Discussion:

Material and energy balance calculation in chemical process plants helps in analyzing resource utilization. It is an essential factor in cost and energy savings in process plants. It also reduces the load on the environment. If small and medium-scale process plants perform only material and energy balance calculations, it will lead to considerable savings and less damage to the environment. One of the aims of this work is to address this issue by making affordable simulators available to small and medium scale industries. Also, much small and medium-scale chemical plant operates in batch mode for which dynamic simulation capability is required in the process simulator. Currently available dynamic process simulators are proprietary and not available free of cost. The focus of the work is to make available a multi faceted process simulation environment that can perform both steady-state and dynamic simulations. It should be open-source so that small and medium-scale process plants and a large number of researchers are benefitted. Open Model is an open-source, equation oriented, multi-domain modeling and simulation environment. It has an in-built system of libraries for various domains such as electrical, hydraulics, mechanics, etc.

TROUBLESHOOTING AND PERFORMANCE IMPROVEMENTS IN ClO2 GENERATOR USING CFD: AN ONGOING STUDY

Dr. Tushar V. Tamhane

(Process and TIS, thyssenkrupp Industrial Solutions (India) Pvt. Ltd.)

Mumbai- 400083, India.

Abstract:

Computational Fluid Dynamics (CFD) has emerged as an effective simulation tool over the past two decades. CFD comprises three major steps in arriving at the solution: (1) Geometry generation and meshing, i.e. resolving the large flow domain into small cells (2) Numerical Simulations (3) Post-processing,i.e. interpreting the results. Many design and EPC companies are gaining the benefits of CFD tools through process design and troubleshooting. As regards the field of Chemical Engineering, CFD is finding increasing applications in the areas of design and scale up, performance improvements and troubleshooting. This is particularly important for the technology companies like thyssenkrupp. In the present study, we have discussed the application of CFD in troubleshooting and performance improvements in ClO2 generator.

1. Problem statement

ClO2 is produced by reacting sodium chlorate with hydrochloric acid:

$$NaClO_3 + 2HCL \rightarrow NaCL + H_2O + \tfrac{1}{2} Cl_2 + ClO_2$$

In the actual equipment, HCl is added to the pool of sodium chlorate at multiple points. Thus, ClO2 is produced discretely in the liquid pool of chlorate. The consequence of this is, that the local concentration of ClO2 varies. It has been observed that, if the local concentration of ClO2 goes above a certain value, the phenomenon of puffing occurs, which is recognized by violent explosions, that eventually lead to shutdown. Thus, puffing has implications both in terms of safety and economics. To deal with this, in the current system, air is spared at different points in the chlorate pool. This is done with the intention of reducing the local concentration of ClO2 below the critical value for puffing. The overall configuration is thus a complex system of three components. The effectiveness of the operation essentially depends on the hydrodynamics within the liquid pool.

INNOVATIVE ' SAND RECLAMTION TECHNOLOGY' FOR THE SUSTAINABLE GROWTH OF FOUNDRIES

Mohd Moiz Khan

(Department of Chemical Engineering, IIT Bombay)

Abstract:

During the casting process in the foundry, molten metal is poured into a mold made from foundry sand. Once the casting is done, the mold is broken and the sand loses its capability of being reused – it must be simply dumped. Waste foundry sand (total clay content 15 %) contains toxic heavy metals and particulate matter which make dumping of waste sand an environmental and health hazard. Right from the rise of the foundry business in India, millions of tons of Waste Foundry Sand (WFS) is being dumped every year without any safe disposal of treatment. Since there is no viable techno-commercial solution available for WFS treatment, the disposal of WFS remains a big challenge to date. A lot of research has been done to use WFS in other industries like construction and ceramics but not much has been done to reclaim and use waste sand within the foundry itself. Stringent government regulations and environmental laws now restrict such dumping. The cost of fresh sand has doubled in the last couple of years due to the ban on dredging in most of the states. To cope up with these issues, we felt that it is the need of the hour to develop a technology capable of reclaiming WFS economically and meeting the foundries requirement, while effectively addressing environmental issues.

Experiments were performed to decrease the total clay content from 15 % to as low as possible in WFS to make it suitable for reuse in the foundry industry. Prototypes were also developed during the course of experiments, namely vertical fluidized bed, horizontal attrition bed, and multi-stage attrition device to reclaim the waste sand. The clay content has been successfully brought down to 2.2 %. The cost per ton of reclaimed sand is higher in case of fluidized bed based prototypes while in the case of a multi-stage attrition device, it is around INR 1000 per ton which is much less than half of the cost of fresh sand.

After getting promising lab-scale results, a pilot plant (Capacity 1 TPD) is built in Kolhapur in the collaboration with Vithoba Enterprises as shown in Figure 1. Vithoba Enterprises is running this plant continuously for more than 5 months with commendable success. Currently, WFS is collected from foundries and reclaimed using this plant. More than 150 tons of sand has been reclaimed to date and tested in the foundries. And the results are exceptional. Going forward, a local foundry (Malati Founders Pvt. Ltd., Kolhapur, India) has tested the reclaimed sand on a bigger scale over a one-month-long trial and thereafter they become our regular customer. The feedback indicates that

the properties of reclaimed san are satisfactory and meet the quality standards after several tests in their in-house lab. A total of more than 2,500 castings have been made by this reclaimed sand, and the quality of these castings is found to be excellent. This one-month trial helps us to disseminate this technology widely and lay the foundation for its go-to-market strategy. The two-stage attrition device represents a breakthrough technology that would appreciably reduce the issue of waste sand disposal. Also, it would cater to the needs of the foundries by making them partially or fully independent of sand mining. It is a holistic approach towards establishing zero-waste foundries, thereby working towards an eco-friendly and greener society. We are also working on chemical reclamation approach to convert waste green sand to core sand which would fetch more profit.

Fig.1. Sand reclamation plant, commissioned at Govt. Polytechnic, Kolhapur

Key words: Waste foundry sand; total clay; Reclamation; Environment; Sustainable; Economics.

A GREEN TECHNOLOGY FOR THE PRODUCTION OF METHYL PENTENONE

(In collaboration between IIT Bombay and Harmony Organics Pvt. Ltd.) Pune

Sumit Kamal1, Rahul Nabar, Sanjay Mahajani1

(1.Department of Chemical Engineering, Indian Institute of Technology Bombay, Mumbai-400076, India 2.Harmony Organics Pvt. Ltd. D-5 MIDC Kurkumbh, Daund Pune-413802, India)

Abstract:

Methyl Pentenone (MPO) is an important fine chemical used in flavour and fragrance (F & F) industry as a precursor for chemicals such as Iso-E-Super, filbertone, Amberonne. Conventionally, MPO is produced by the aldol condensation reaction of methyl ethyl ketone (MEK) and acetaldehyde (AcH) in the presence of sulphuric acid. The yield of MPO obtained is nearly 70% with a semi-batch addition of acetaldehyde in a mixed pool of MEK and sulfuric acid. Amberlyst-15 (activity 4.7 meq/g), a cation exchange resin, used as heterogeneous catalyst, has advantages over sulfuric acid, for the latter deals with corrosion, salt handing and safety.

Kinetic studies are carried out in the presence of Amberlyst-15 with an objective of designing a reactor operating in a temperature range of 343-363 K. Kinetic experiments are conducted to understand the effect of temperature, composition and catalyst loading over reaction rate. Kinetics modeling performed using Langmuir-Hinshelwood-Hougen-Watson (LHHW) model predicts experimental results satisfactorily with 90% confidence interval.

Deactivation of the heterogenous catalyst is inevitable due to multiple reasons. Analysis confirm that the catalyst deactivation is mainly due to desulphonation followed by metal and high boiler deposition on the catalyst active sites. Furthermore, a novel protocol has been devised for catalyst regeneration. It has been demonstrated that by alternating steps of a physical treatment (to remove physically adsorbed impurities) and a chemical treatment (to oxidize deposited impurities) followed by resulphonation, the deactivated catalyst can be effectively brought back to a state with an activity as good as the fresh catalyst.

Based on the indigenously developed kinetic model, MPO yield is increased to 85-87 % using semi-batch addition of acetaldehyde in a pool of MEK in synergy with reaction conditions. However, continuous production of MPO is demonstrated in fixed bed reactor (FBR) with more than 200 hours at 80% MPO yield. The data suggests that the MPO yield increases with decreasing

acetaldehyde content in the feed mixture, which is in line with what has been observed in batch and semi-batch reactor studies.

The production of MPO via semi-batch reactor is upgraded to a continuous mode using a fixed bed reactor with side injection. The advantages of the proposed method include low production cost and no effluent generation. Pilot level scale up of the reactor prototype is performed at the scale up volume ratio of 1:120.

It is observed from the techno-commercial feasibility analysis that for the production of nearly 100 kg of MPO per kg of Amberlyst-15 at 80 % MPO yield, revenue of MPO production is equivalent to that obtained by producing 100 kg of MPO from sulfuric acid. In the proposed process, this objective has been successfully achieved in laboratory. Typically, the production of 500-ton MPO using conventional process, requires 60 ton of base neutralizer and 660 ton of water. In addition to this, there is a generation of 200 ton of salts, and 25 ton of CO2 along with the loss of 90 ton of organic during neutralization. The proposed process has a potential to eliminate all these problems.

FUTURE READY MANUFACTURING

Presented by- Kalpesh Khedekar, Sagar Mate & Rushikesh Musale

Godrej Industries Ltd. (Chemicals Division)

Abstract:

It is believed that the future of manufacturing is smart. Smart manufacturing marries information, technology and human ingenuity to bring about a rapid revolution in the development and application of manufacturing intelligence to every aspect of business. As manufacturing facilities move towards the smart factory concept, there will be a need for real-time performance management across multiple facilities. Adoption of advanced solutions leads to high levels of data availability, which will further create a need for robust control, capable of converting it into actionable intelligence and enhanced operational excellence by Increasing data accessibility, availability, and agility. One of the biggest benefits of employing an analytics-led approach lies in the simplification of data. Traditional manufacturing data sets are very complex and often require specialists with system-specific knowledge and expertise to glean insights from them. Objective is to make the data available in an easily consumable and understandable visual format. This not only helped the organisation cut down on the time and effort spent in creating manual reports, but also triggered the transition from a report-led approach to an insight-driven work culture. Industry 4.0 will require standardization at multiple levels – processes, connectivity, systems and people maturity.

At Godrej Industries Limited (Chemicals), Ambernath we have started our journey in following areas.

- Boilers & Steam Network.
- Heat Exchanger Network and performance monitoring.
- Optimizing efficiency of Centralize Air Compressor & Nitrogen plant.

REVOLUATION IN INDUSTRIAL OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT

Pratik S Jadhav

(Assistant Manager- Corporate EHS, Prism Johnson Limited H & R Johnson)

Abstract:

A technological revolution increases productivity and efficiency. It may involve material or ideological changes caused by the introduction of a device or system. Some examples of its potential impact are business management, education, social interactions, finance and research methodology; it is not limited strictly to technical aspects.

Real-time communication, Big Data, man–machine cooperation, remote sensing, monitoring and control, autonomous equipment and interconnectivity are all considered as non-negligible assets in industries that face fierce competition and seek to improve productivity and reduce costs.

KEYWORDS: Real Time Communication, Big Data

1. INTRODUCTION- REVOLUTION IN INDUSTRY 4.0

Industrialization has undergone remarkable transformations since beginnings in the 18th Century starting from invention of machinery to increase the efficiency of Human Manual efforts. Industry 1.0 refers to the first industrial revolution.

The Paradigm shift came in 19th Century with introduction of electricity, which allowed the broad distribution of power from a central facility. A great thanks to electricity, where machinery became less bulky and ran faster in (Industry 2.0).

Later in 20th Century Industry became more automated in (Industry 3.0) which focuses more on performance of Man and Machines.

At present in (Industry 4.0) which was launched recently, a great digital revolution on Artificial Intelligence, IOT-Internet of Things where every device came up with “Smart Technologies”.

The concept includes:

- Smart manufacturing
- Smart factory
- Lights out (manufacturing) also known as dark factories.
- Industrial internet of things also called internet of things (IOT) for manufacturing.

2. COMPONENTS OF INDUSTRY 4.0

“Industry 4.0” is an abstract and complex term consisting of many components when looking closely into our society and current digital trends. To understand how extensive these components are, here are some contributing digital technologies as examples:

- Mobile devices
- Internet of Things (IoT) platforms
- Location detection technologies
- Advanced human-machine interfaces
- Authentication and fraud detection
- 3D printing
- Smart sensors
- Big data analytics and advanced algorithms
- Multilevel customer interaction and customer profiling
- Augmented reality/ wearable
- Fog, Edge and Cloud computing
- Data visualization and triggered & quot; real-time & quot; training.

Mainly these technologies can be summarized into four major components, defining the term

“Industry 4.0” or “smart factory”.

- Organization of Work
- Legislative and Regulatory Frame work
- OHS Management systems
- Management of Occupational Risks

3. SMART TECHNO-INDUSTRY:

We at Prism Johnson Limited H & R Johnson (I) Division manufacturing of Ceramic Tiles Established in 1958 is the pioneer of ceramic tiles in India. Over the past six decades, H & R Johnson (India) has added various product categories to offer complete solutions to its customers We also adapt new technologies and Innovations which has shown an positive impact on business and as well as development of the organization.

As per the need of the time we have developed our manufacturing process in line with technologies where Man and Machines intervention is inter linked with Smart Technologies which resulted in increasing the efficiency of both.

Some of our Smart Technologies adopted at various Manufacturing plants:

1) Digital Printing of Tiles

2) Vacuum Lifter

3) LGV: Laser Guided Vehicles

4) Online reporting of Near Misses :(Reporting of Unsafe Act/Conditions)

4. CONCLUSION

The term “Industry 4.0” referring to a fourth industrial revolution is a very recent neologism. The rise of digital technology, artificial intelligence, the Internet of things and networked, “smart” and responsive devices is seen more and more as providing means of responding to changing consumer demand more quickly and efficiently. This vision has gone well beyond equipment in factories and is becoming a global revolution that will soon transform the very notion of what constitutes a manufacturing facility. Ultimately revolution in Industry has proven a great change in Wellness of people and also OSH Management.

5. REFERENCES

- Wikipedia Industry 4.0
- SOP of H & R Johnson (I) Division Tile manufacturing plant

Report on OYCE 2020

The 13th Outstanding Young Chemical Engineer's contest was held at Institute of Chemical Technology on the 15th February 2020. In all 35 entries were received for the contest divided into 2 categories as Undergraduate students (21 entries) and working Professionals category (14 entries). The participation in the UG category comprised of students from Datta Meghe College of Engineering, Visvesvaraya National Institute of Technology, Gharda Institute of Technology, IIT Bombay, Institute of Chemical Technology etc. whereas participants in Working Professionals category were from RCF Chembur, HWB-DAE, Thyssenkrupp, Harmony Organics, IIT Bombay etc.

The contest started with inaugural function with Mr. Vinayak Marathe, Sr. VP R&D, RIL as the special Guest. Dr. Parag Gogate, Convener of the OYCE-2020 compeered the function and welcomed the participants. Prof. Patwardhan, Head, Chemical Engineering Department at ICT and Prof. A.B. Pandit, Vice Chacellor, ICT also gave guidance to the participants on the role of chemical engineering and future prospects. Shri. Vinayak Marathe, in his encouraging talk to the young participants, highlighted the concept of innovation. Dr. Gogate introduced the judges for the events which included Mr. Thomas Mathew, Dr. Aniruddha Shenvi and Smt. Satyashwini for the Undergraduate category whereas the judges for the Working Professional category included Mr. O. P. Goyal, Mr. Sushil Kumar and Mr. Jagdish Nageshri. The inaugural function ended with vote of thanks given by Shri. Dhaval Saxena (BCPL, IIChE).

The presentations during the contest covered areas such as Cavitation in desulfurization of thiophene, modeling of abandoned oil and gas field, nanotechnology and nano-fluids, alternative fuels, recovery of valuable materials etc. in the Undergraduate category. The topics for the presentations in working professionals category were Process safety, innovative techniques in Complex Fertilizer Plant, Sodium Production by Electrolysis, troubleshooting of equipment and plants, Chemical Process Simulation using OpenModelica and DWSIM, etc. All the presentations were of exceptional quality as remarked by the judges in the valedictory function.

After the presentations, Shri. Rajesh Kumar Gera, RIL spoke about recycle of plastic waste material to reusable carry bags and also highlighted the efforts of RIL in sustainability and recycle.

Subsequently, there was a panel discussion regarding the recent trend in chemical engineering with panelist as Shri. Jagdish Nageshri (HWB, Mum), Shri. Umang Shah (Clariant), Shri. Thomas Mathew (RIL), Dr. Rahul Nabar (IITB, Harmony Organics), Shri. Rajesh Kumar Gera (RIL), Shri. J. P. Soni (thyssen krupp). The panel discussion was moderated by Shri. Praveen Kumar Saxena, Blast Carboblocks. The discussion was well received by all the participants.

The valedictory function had Mr. V.K. Joshi as the chief guest from Thyssen Krupp, Mr. A. K. Saxena of Blast Carboblocks and Mr. Kamachi Mudali, Chairman of IIChE MRC, Prof. A. B. Pandit, Vice chancellor of ICT Mumbai was also the honorable guest for the function. Mr Kamachi Mudali, Chairman IICHE-MRC gave an overview about OYCE and the activities of the Mumbai Regional Center of the IIChE. Mr. V.K. Joshi and Mr. A.K. Saxena gave enlightening message to the young participants also highlighting the steps for a successful career and technology innovations. Certificate of participation were given to all the participants at the hands of chief guest, chairman of the IIChE MRC and the guest of honor. Certificates were also given to the student volunteers who worked day and night for making the event a grand success. Subsequently Dr. Gogate announced the winners in both the categories. Thyssen Krupp sponsored the prizes in the Post Graduate Graduate category whereas the prizes in the Undergraduate category were sponsored by Blast Carboblocks. In the working professional category, the competition was very tough and judges had hard time in finalizing the winners. Mr. Vidyanand Ramchandra Kudtarkar (RCFL,Mumbai) and Mr. Priyam Nayak (FOSSEE, IIT Bombay) were declared as joint first prize winners. Mr. Nitesh Parsai (HWB, DAE, Mumbai) won the second prize and Mr. Sumit Kamal (IIT Bombay) won the third prize. In the Undergraduate category the first prize was jointly given to Ashlesha Tiple (ICT Mumbai) and Arjav Shah (IIT Bombay). Team of Sudeep Mohanty, Yash Modi and Itika Samar of Mukesh Patel School for Technology Management and Engineering, Mumbai won the second prize. Shriley kokane (ICT Mumbai) and Gaurav Jadhav (Gharda Institute of Technology) were given the third prize jointly.

A Special thanks to Reliance Industries Ltd. for being the title sponsors for the event. A special thanks also to thyssenkrupp and Blast Carboblocks for sponsoring the prizes for the Working professionals and undergraduate categories for the event.

Photos Gallery

Inaugral Session Chief Guest Shri Vinayak Marthe

Address By Prof, A B Pandit

Panelists

Guests

Prize Distribution to Undergraduate category

Prize Distribution to Working officials Category

MONTAGE CHEMICALS PVT. LTD.

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The company was established in 1987 by Mr. Ajai Chaturvedi, a technocrat turned businessman, Mr. Chaturvedi, a graduate of IIT Kanpur and JBIMS, served as the Vice-President of an MNC before establishing Montage Chemicals. In this venture he was ably supported by Mrs. Ajai Chaturvedi who is now the managing director of the company.

We initially started out with the manufacture of

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2. Allantoin and its derivatives like Aldioxa and Alcloxa

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• Vision: We aim to be a global leader in pharmaceutical, feed supplement and specialty chemicals production by using sustainable technology

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STUDY CASE:

A Study of the Costing and Financial Analysis of Quality Management Systems in the Active Pharmaceutical Ingredients (API's) Industry

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GMP in the Pharmaceutical Industry

GMP or "Good Manufacturing Practices"is that part of quality assurance which ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use and as required by marketing authorization" (WHO 2004).

GMP guidelines represent minimal standards that are a necessary condition for marketing authorization. Drugs are considered to be adulterated, if GMPs are not met. GMP standards are, however, only guidelines and alternative processes and control mechanisms can be used under the condition that equivalent assurance is attained.

GMP guidelines typically comprise strong recommendations on quality management, personnel, production facilities and equipment, documentation and records, production and in−process controls, packaging and identification labeling, storage and distribution, laboratory controls, validation, complaints and recalls, and contract manufacturers.

The growth of pharmaceutical market in India has been very eye-popping during the last two decades. The growth of pharmaceutical market depends upon the various factors among one is drug regulatory system and regulatory legislations. Current scenario of drug regulatory system in India is on the way of continuous improvement and under transition phase viz., Strengthening of Central licensing agency, introduction of gazette notifications and amendment, formation of committees (SEC/NDAC, expert, technical and apex).

As understood, in recent years QMS (Quality Management Systems) have acquired prime importance in the API industry. As the industry becomes more tightly regulated, the so called cost of quality (COQ) becomes an important factor in the end cost/pricing of the product. The API market accounts for about 30% of the total chemical market in India by volume and is expected to increase. In light of this, those firms who are able to manage the COQ of their products and at the same time meet the regulatory requirement are certain to thrive. So far, our literature review has not yielded any detailed study on this financial implication of this cost in end product pricing as well as the cost of conducting vendor audits, self audits and external inspections/audits has not been analyzed from a operational and financial view point. This problem of COQ is becoming especially acute in the low margin (high volume and moderately priced) pharmaceuticals and is fast spiraling out of control. Consider this case with the help of an example. In my current organization, a particular product (say A), costs about Rs. 370 to manufacture (this price only includes the raw

material, processing, utility and manpower costs). However the product is an active drug and to ensure compliance with cGMP (Current Good Manufacturing Practices), we have to engage lots of excess manpower and ensure the process sticks to its validated guidelines. The manufacturing facility has to be kept extremely clean and must be temperature controlled. This is mandated by the company QMS, but we estimate that it adds about Rs.20-30/- to the product cost which now becomes roughly Rs.400/Kg. To this cost is added the marketing, other overheads and transportation costs which brings the product price to about Rs. 450/- (The product is sold in the market at Rs. 500/Kg). If the COQ can be minimized, then the profit margin can be increased by at least 2%, and hence it is imperative that this little known but high impact cost is analyzed financially and minimized so as to ensure better margins and more profits and at the same time should not compromise the product quality. Another part of the project will focus on controlling the cost of conduction audits as well as being audited (Including dossier submission to regulatory authorities). The financial implications of these are often overlooked , although it plays a significant role in product costing.

The most important factors which are responsible for adding to the cost of quality are:

1) Analysis of raw material

2) Vendor qualification and audits

3) In-process quality checking

4) Final product analysis and GMP environment cost

The following results were observed

Sr No.	Quality Activity	Cost/Kg of finished product (Rs)	Weight age as percentage of total quality cost
1	Checking of Raw Materials	77	26.82%
2	In-Process Quality Checks	50	17.42%
3	Finished Quality testing	100	34.84%
4	GMP environment cost (Including paperwork, training and other environment controls)	60	20.90%
5	Total Cost of ensuring quality	287	-

We have also calculated the relative impact of these quality cost on the final price of the product and the results are tabulated below: (Cost of final product is Rs. 550/kg)

Sr No.	Quality Activity	Cost/Kg of finished product (Rs)	Weight age as percentage of total product cost
1	Checking of Raw Materials	77	14.00%
2	In-Process Quality Checks	50	9.09%
3	Finished Quality testing	100	18.18%
4	GMP environment cost (Including paperwork, training and other environment controls)	60	10.90%
5	Total Cost of ensuring quality	287	-

It can be thus seen that approximately about 53% of the total product cost is the cost of quality. This has been a revelation and points to the facts that about half the cost of pharmaceutical products comes from the cost of quality.

Suggestions

Process analytical technologies Process analytical technologies (PAT); play a key role in enabling ‘‘quality by design’’ and scientific aspect of manufacturing. PAT’s main aim is to understand and control the manufacturing process through the application of integrated chemical, physical, microbiological, mathematical and risk analysis methods. PAT has been applied in non-Pharma industries for many years, yielding cost savings and manufacturing efficiencies .The implementation of process analytical technology (PAT) is bringing lots of benefits and improvements for many pharmaceutical processes. The benefits are lower production cycle times, improved manufacturing efficiency, reduced rejects and increased production operating time. Within pharmaceutical industry, there have been a number of successful PAT-based comparability protocol submissions, ranging from single-unit operation application at GlaxoSmithKline to a more all-including application covering both drug substance and drug product at Sanofi-Aventis

Lean manufacturing: Japanese manufacturers re-building after the Second World War wer facing declining human, material, and financial resources. These circumstances led to the development of new, lower cost, manufacturing practices. Early Japanese leaders such as the Toyota Motor Company’s Eiji Toyoda, Taiichi Ohno, and Shingeo Shingo developed a disciplined, process-focused production system now known as the ‘‘Toyota Production System’’, or ‘‘lean production.’’ The objective of this system was to minimize the consumption of resources that added no value to a product Lean manufacturing is about eliminating waste across an entire company and focusing on the big picture through learning how to do more with less. Lean means putting the right things in the right place at the right time the first time while minimizing waste and being open to change. This leads to less waste, less design time, fewer organizational layers, and fewer suppliers with more employee empowerment, more flexibility and capability, more productivity, more customer satisfaction and without a doubt, more long term competitive success. Lean principles incorporated in the workplace today can spell business survival for the future In AstraZeneca; rather than being submerged into Lean, the company launched a limited initiative at its global facilities in 2002 which is the Pull Manufacturing; this initiative required that the company’s manufacturing teams shift their focus from output to customer alignment and service. Also, the initiative has lead to reduction in the cycle time. In during a period when demand for the drug was increasing by 30%.

Total quality management Total quality management (TQM) is a concept rather than a technique. It is a philosophy that stresses a systematic, integrated, and consistent perspective that would involve everyone and everything in the organization (Isaac et al., 2004). TQM is a management philosophy that builds a customer driven, learning organization that is devoted to the total customer satisfaction through continuous improvement in the effectiveness and efficiency of the organization and its corresponding processes (Corrigan, 1995). TQM is widely known for improving quality and other performances such as productivity, profit, market share, and competitive edge of organizations of various types (Sun, 2000; Isaac et al., 2004). 2.2.9. ISO series ISO 9000 series: ISO 9000 is concerned with ‘‘quality management’’. This means what the organization does to increase customer satisfaction through meeting customer and regulatory requirements and continually improving its performance (ISO 9000 and 14001 in brief, 2009). ISO 14000: ISO 14000 is an environmental management system, describes the requirements for an organization’s environmental

management system and can be used for certification/registration and/or self declaration of an organization's environmental management system (ISO 14001, 2004). This means what the organization does to (ISO 9000 and 14001 in brief, 2009): Minimize harmful effects on the environment caused by its activities. Achieve continual improvement of its environmental performance. ISO 17025: It gives the general requirements for the competence of testing and calibration laboratories (ISO/IEC 17025, 2005). A specific version of this standard for Medical Laboratories has been developed; ISO 15189:2003 then ISO 15189, 2007 was published on 19th April 2007 (ISO 15189, 2007). Through the accreditation process; the testing laboratory reaches the status of an independent institution.

HACCP The Hazard Analysis and Critical Control Point (HACCP) methodology was known to be a safety management system used in the food industry. Their main aim is to prevent known hazards and to reduce the risks that they will cause at specific points in the food chain (Annex 7; WHO TRS No. 908, 2003). Procedures, including GMP, address operational conditions and provide the basis for HACCP. HACCP is a systematic method for the identification, assessment and control of safety hazards. The hazards are classified as biological, chemical, or physical agents or operations that might cause illness or injury if not controlled. In the manufacture of pharmaceuticals, this includes the manufacture of certain antibiotics, hormones, cytotoxic substances or other highly active pharmaceuticals. Together with operations such as fluid bed drying, granulation is an example of hazard unit operations. The use of inflammable solvents (solutions) and certain laboratory operations may also produce hazards (Annex 7; WHO TRS No. 908, 2003). The HACCP system is based on seven principles (Annex 7; WHO TRS No. 908, 2003): Conduct a hazard analysis. Determine the critical control points (CCPs). Establish target levels and critical limit(s). Establish a system to monitor the CCPs. Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control. Establish procedures to verify that the HACCP system is working effectively. Establish documentation concerning all procedures and keep records appropriate to these principles and their application. Since the cost of quality is about 53% of the total quality cost and a majority of that cost is due raw material and finished product quality testing and the least amount of the cost is taken up by the in-process quality checks, the following is observed

- Scale up the intensity of the audits of the raw material manufacturers

- Ensure they comply with ISO/GMP standards

- This will enable us to accept raw materials without much testing

- Properly validate the manufacturing process for manufacture of API's

- This will ensure that the quality of the finished product remains within acceptable parameters

- Increase the intensity of In-Process quality checks, this will ensure robustness in the process

- If the process is properly validated then there is not much need for emphasis on end product testing

- Ensure the bare minimum cost is spent on finished product analysis, this will bring down the overall cost

- Even if 20% of the cost is reduced, it will have a huge impact on the overall product costing and pricing

Qualitatively assuming that even if 20% of the overall product quality costing is reduced, the following impact will be seen 20% of Rs. 287= Rs.57.4/- Thus new cost of quality will be Rs. 287- Rs. 57.4= Rs.230/-

The below table shows the impact of quality if the cost is reduced by 20%

Sr No.	Year	Total Sales (Tonnes/Year)	% Decline in sales (Qty)	Amount spent on Quality (Rs)	Operating Revenue from sales of product (Rs.)	Amount spent on quality as percentage of operating revenue (%)
1	2018	55	-23.61%	9734450	30250000	32.18%
2	2017	60	-16.67%	10619400	33000000	
3	2016	67	-6.95%	11858330	36850000	
4	2015	72	Base	12743280	39600000	

In conclusion, the following aspects are clear

- Cost of quality in the API industry remains a challenging issue especially in the SME sector

- Cost of quality analysis accounts for a major chunk of the product costing due to the sophisticated instrumentation involved and the practices followed

- GMP activities are often overdone and thus cause escalation in the cost

- The Indian pharmaceutical industry has taken a lot of hits from the Chinese market and if we reduce the cost of quality management then we can be more competitive

- The cost of quality and product pricing can indeed be reduced a lot, provided we give an impetus to it.

From the study which has been conducted above and the results which have been present in the report, qualitatively speaking about 20% of the overall drug cost can be reduced if the cost of quality is reduced. This will not affect the overall quality of the drug, but this scale down in the cost of quality can be achieved by:-

- Proper vendor audits

- Relaxing of input quality testing by reliance on vendor testing

- Robust and rigid in-process quality testing

- Relaxing of regulations for finished product testing, by reliance on in-process quality checks

- Proper and robust and fail-safe equipment qualifications techniques and process validation techniques

Impact of Balanced Meal & Discipline on the Overall Performance of the Individual

Abstract: People mostly get confused between Nutritious Foods vs Balanced Foods. Nutritious Foods are the foods which provide nutrients (which may or may not be balanced). Balanced Food is a meal which is a combination of various Nutritious Foods chosen based on individuals' need of the nutrients. Human body responds to properly cooked foods in much better manner than meal replacements. Hence when eating habits of individuals have been shifted from eating only nutritious foods to properly cooked balanced food plate, lot of positive changes are visible. Further, discipline and following advice patiently also plays an important role in this whole process. One such case study of an athlete has been elaborated below for illustration of role of Foods & Discipline in Our Daily Activities.

Introduction:

People mostly get confused between Nutritious Foods vs Balanced Foods. Nutritious Foods are nutrients rich foods which may or may not be balanced. Nutrient requirements varies from person to person based on multiple aspects, mainly Daily Routine, Physical Activity, Body Dimensions, Stress level etc. Balanced Food is a meal which is a combination of various Nutritious Foods chosen based on individuals' need of the nutrients.

For example, Oats, Fruits, Eggs are Nutritious but those are not balanced. Oats, Fruits or Eggs only provide certain nutrients, so other food ingredients will be needed to make a Balanced Meal out of Oats, Fruits or Eggs. Unfortunately, many people do not understand this basic concept and that's where the desired results are not visible.

Human body responds to properly cooked foods in much better manner than meal replacements. Hence, we have developed our Diet Planning and Counseling activities such that the concerned individual, following our advice shall be eating Balanced Meal in form of Real Food (Not Meal Replacements or Liquid Diets or Just Salads)

Herewith explaining an Impact of Balanced Meal and Discipline on performance of Individual with a case study of a 12 year old Athlete whose parents bring him to us with two objectives 1) Increase Weight 2) Increase Stamina and Speed.

Case Details:

The Individual was undergoing training for last few months with a dedicated coach from school. Considering the fragile frame and lower weight (36 kg) of individual, coach had advised parents to increase protein intake and suggested to consume 4-5 Eggs, Nuts and Dry Fruits per day. No other suggestions were given to improve other nutrients, minerals, vitamins in regular meals or snacks. However, despite following the instructions from coach, weight of the individual was not increasing Further, he was getting tired too soon (within 15-20 minutes) during training.

After body checkup and understanding daily routine of the individual, following things were observed.

a. He was having early morning school and first meal (breakfast) he used to have was almost around 9:30-9:40 am

b. His next meal (lunch) was around 1:30-1:40 pm, after coming back from school

c. No meals before & after training session (5:00-6:30 pm)

d. He was taking his 3rd meal in form of dinner around 8:20-8:30 pm

e. Consuming almost 2 Eggs during 1st meal (breakfast) and 2 Eggs during last meal (dinner)

f. Total calorie intake was lower by almost 300-350 Kcal, water intake was lower by almost 1 liter, intake of minerals and vitamins was also less than required

After counseling session, following things were identified as probable causes for not increasing weight and lower stamina of the individual

a. Lower calorie intake with diet skewed towards too much Protein

b. Almost 13+ hours of fasting between Dinner & Morning Breakfast

c. Uneven distribution of meal timing without understanding energy requirement during particular time in a day

d. No intake of Pre Workout and Post Workout meals affecting performance during training session and also affecting recovery

e. Very little focus on minerals and vitamins contents in diet which are very much crucial and essential for growing kids

Solution:

It was quite clear that individual was not getting right amount of energy at his disposition when he needed it most. Recovery of depleted energy (Glycogen Replenishment after training session) was

relatively slower. Further, less focus on minerals and vitamins in diet might have been probable cause for slower muscle recovery and weight gain.

We had reworked eating pattern of the individual so as to match with his daily routine. Following changes were made.

a. Increased total meals from 3 to 6 with total increase in calories by 300 Kcal

b. Improved hydration by introducing liquid foods like Daal, Buttermilk, Soup in lunch & dinner

c. Introduced a 15-20 min aerobic exercise immediately after waking up in morning

d. 1st meal at 7:00 am, before leaving for school

e. 2nd meal at 9:30 – 9:40 am, Eggs reduced from 2 to 1 and introduced regular snacks like Poha / Paratha / Upama / Uttapa etc with improved nutrients (protein, fibers, vitamins and minerals) as alternative to Eggs

f. 3rd meal at 12:40 – 12:50 am, proper lunch with improved nutrients

g. 4th meal at 4:00 pm, almost 1 hour before the training session. This is a Carbohydrate and Protein based meal. Banamin HealthyBhoj ButterMilk Mix included. 1 boiled egg given as an option.

h. 5th meal at 7:30 – 7:40 pm, within 30 minutes after the training session. This is mainly Carbohydrate rich meal.

i. 6th meal at 8:30 – 8:40 pm, proper dinner with improved nutrients. Banamin Healthy Bhoj Soup Mix has been included. Eggs reduced from 2 to 0.

Results and Discussion:

As the calorie intake was increased, during 1st week, individual was feeling that he wouldn't be able to consume all those meals. So we had reduced a portion of Lunch (3rd meal) for first 3 days. Within a week, he was able to overcome the feeling of overeating and we had adjusted the intake as per the proposed quantity.

Following changes were visible after 21 days,

a. Individual was feeling more cheerful

b. He was able to perform well during training session

c. Training timing without getting tired increased to almost 30 min (from 15-20 min)

d. Less complaints about leg cramps and muscle aches

e. Weight increased to 37.9 kg (1.9 kg increase)

After 6 weeks, following changes were observed,

a. Training timing without getting tired have been further improved to 40 min

b. Speed was increased

c. Cheerfulness increased

d. Almost no complaints about leg cramps and muscle aches

e. Weight increased to 38.5 kg (0.6 kg increase)

After 3 months, following changes were observed,

a. Training timing without getting tired have been further improved to 45-50 min

b. Weight increased to 39 kg (0.5 kg increase)

The positive results can mainly be attributed to following facts,

a. Patience & perseverance of the individual.

b. The determination & discipline with which he had followed the advice for 3+ months without break helped a lot.

c. Gap between calorie required and calorie consumed has been filled up

d. Reduced Fasting duration between dinner & breakfast from 13+ hours to about 10 hours

e. Earlier diet which was skewed towards protein has been shifted to Balanced meals where right nutrients and right calories are provided

f. Introduction of Pre Workout and Post workout meal helped to improve

    a. Fat Burning capability of body when doing high physical activity (>2 minutes)

    b. Improved recovery (Faster Glycogen Replenishment, Muscle Tissue Recovery)

    c. Reduced Cramps and aches

g. Lunch and Dinner timings adjusted so as to accommodate the High Energy Consumption period for body

h. Improved overall nutrient contents of all the meals

i. All the meals were designed such that the other family members were also eating the same food as the individual was eating. Which helped a lot from psychological angle as individual did not feel that he had been alienated and forced to eat bland, tasteless foods on the name of Nutrition

Conclusion:

Each individual has certain requirement of nutrients to perform well during daily activities and this requirement varies from person to person. Hence a generic solution never works when it comes to give a diet advice. Contrary to general notions, Consuming Highly Nutritious foods or Meal Replacements or Raw Foods alone does not help to the cause of Good Health. Major focus for any diet advice should be on balancing the plate with right nutrients, right calories and Managing Eating Timing. Another crucial factor for achieving success is the strict adherence to the Meal Portions & Meal Timing. As like any other field, patience, discipline and self belief helps a lot in managing Healthy Life too and if followed properly, one can easily see the positive changes in his / her health

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Nikhil Gandhi is a Chemical Engineer, topped university amongst all colleges and branches. Felicitated by Institute of Engineers for his academic achievements. He has been associated with Indian Oil for 6 years and Shell Malaysia for 8 years in various roles related to Strategy, Profit Improvement and Economics & Scheduling. He is one of the experts in Crude Oil Evaluations, Petroleum Pricing, Long term & Short Term Strategy Studies, Investment Studies.

In 2016, he quit the job and started a Food based Healthcare Startup (Banamin Healthcare) at Vadodara, Gujarat. Banamin Healthcare has been established with a Vision to develop novel vegetarian healthcare products which will be suitable for today's busy and stressful lifestyle. He is also running a Diet Planning & Counseling center at Vadodara. He and his team has firm belief that Plant Based Real food is the best way to keep a person Healthy, Cheerful, Fit and Active throughout his life. Driven with mantra of "Giving Back to Society", he and his team is working round the clock to develop various initiatives so as to move towards their Goal of "Building Healthier India".

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