Orissa Chemical Society

Regd. No. 18990/28-87/XXVII-22/87 of 1987 – 1988
Website: https://www.ocs.org.in
Email: info@ocs.org.in

FIRST OCS-INDUSTRY INTERFACE MEET 2020

International Conference on

Challenges and Opportunities in Making Industrial Research as a Career Option

Proceedings

Organized in collaboration with

Mining Minerals Metals and Materials Society of India (4MSI)

Website: http://www.4msi.in

26th and 27th December 2020

Program

Day 1: 26th Dec 2020, Saturday

Inaugural Session: 09.30 – 10.00 AM

Session Chair: President, OCS

Dr. Shashadhar Samal

Retired Principal

PRESIDENT, OCS

09.30 – 09.35 AM, Welcome Address

Dr. Surendra Kumar Biswal

Chief Scientist, CSIR-IMMT, Bhubaneswar

PRESIDENT, 4MSI

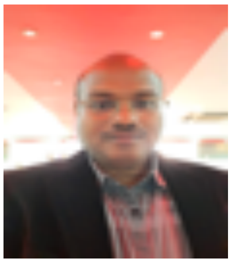
09.35 – 09.40 AM, Welcome Address

Dr. Priyaranjan Mohapatra

Associate Professor, VSSUT, Burla

Secretary-cum-Treasurer, OCS

09.40 – 09.45 AM, Vision of OCS-INDUSTRY INTERFACE MEET



Dr. Tapan Kumar Rout

Principal Scientist, Surface Engineering, Tata Steel Ltd, General Secretary 4MSI

Organizing Secretary,

OCS-INDUSTRY INTERFACE MEET

09.45 – 09.50 AM, Importance of Academic Research in Industrial R&D Activities

Dr. Rama Ch. Rout

Asst. Vice-President - Corporate Affairs, HINDALCO (ADITYA BIRLA), Bhubaneswar

CONVENOR

OCS-Industry Interface Meet 2020

09.50 – 09.55 AM, Exposing Front-line Industrial Research to Students in Non-Technical Institutions

Dr. Debasis Mohanty

Head, Department of Chemistry

Dhenkanal Autonomous College

Co-CONVENOR & Webinar Admin

OCS-Industry Interface Meet 2020

09.55 – 10.00 AM Briefing on the Webinar Protocols

Day 1

26th December 2020, Saturday

TECHNICAL SESSIONS

Technical Session I: 10.00 – 11.00 AM

Session Chair: Dr. Chitta Ranjan Mishra

Dr. Chitta Ranjan Mishra
Deputy General Manager & Head, Research & Development, NALCO (Retired)

Dr. Bankim Chandra Tripathy
Senior Principal Scientist
IMMT, Bhubaneswar

Sri Pratap Chandra Sahu
General Manager: Process
Hindalco Industries Limited

10.00 – 10.30 AM	NRDC Award Lecture **Dr. Bankim Chandra Tripathy** Senior Principal Scientist IMMT, Bhubaneswar	Alum from Aluminium Dross Rejects – A Journey from Lab to Land
10.30 – 11.00 AM	Invited talk **Sri Pratap Chandra Sahu** General Manager: Process Hindalco Industries Limited Renukut, UP	Evolution of Aluminium Smelting and Latest Developments in Aluminium Smelters

Technical Session II: 11.00 – 12.30 PM
Session Chair: Prof. Ashok Kumar Mishra

Prof. Ashok Kumar Mishra
Professor, Department of Chemistry, IIT Madras

Dr. Ratikant Mishra
Head, Thermodynamics and Pure Materials Section Chemistry Division, BARC

Dr. Rashmi Ranjan Mohanty
Co-founder and Director-Technical, ADVENT CHEMBIO PVT LTD.

Dr. Subhash Mallick
Director, L N INDTECH SERVICES PVT LTD., Bhubaneswar

11.00 – 11.30 AM	Invited talk **Dr. Ratikant Mishra** Head, Thermodynamics and Pure Materials Section, Chemistry Division, BARC	Ultra-Purification of Materials and Their Applications
11.30 – 12.00 Noon	Invited talk **Dr. Rashmi Ranjan Mohanty** Co-founder and Director-Technical, ADVENT CHEMBIO PRIVATE LIMITED	Fine & Specialty Chemicals Industry in India: Plethora of Opportunities
12.00 – 12.30 PM	Invited talk **Dr. Subhash Chandra Mallick** Director, L N INDTECH SERVICES Pvt Ltd., Bhubaneswar	Innovation in Wastewater Treatment Technology

Technical Session III: 12.30 – 01.30 PM
Session Chair: Prof. Asutosh Samantaray

Prof. Asutosh Samantaray
Professor of Chemistry (Retired)
College of Basic Science & Humanities, OUAT, Bhubaneswar

Sri Chinmaya Chandra Nayak
Head R&D (industrial)
Shalimar Paints

Dr. Baidyanath Mishra
Chief Executive Officer-
S2 WELLNESS RESEARCH PVT LTD, Bangalore

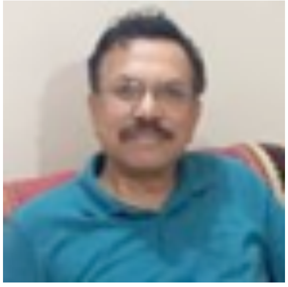
12.30 – 01.00 PM	Invited talk **Sri Chinmaya Chandra Nayak** Head R&D, Shalimar Paints	An Overview on Skill Set Requirements in Industrial Coating Segment for Next Decade
01.00 – 01.30 PM	Invited talk **Dr. Baidyanath Mishra** Chief Executive Officer- S2 WELLNESS RESEARCH PVT LTD, Bangalore	Career Opportunity on Natural Products - Its Discovery, Standardization, and Marketing

Announcement: Day 2 Meeting Starts at 10 AM

Day 1 Sessions are closed

Day 2: 27th December 2020, Sunday

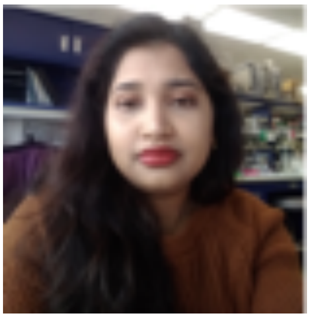
Technical Session IV: 10.00 – 11.30 AM
Session Chair: Prof. Satyaban Jena



Prof. Satyaban Jena
Professor of Chemistry (Retired)
Utkal University, Vani Vihar, Bhubaneswar

Dr. Narendra Kumar Tripathy
Director (Vice-President)
API R&D,
Emcure Pharmaceuticals Ltd,
Pune

Dr. Subhra Mohanty
Group Leader, Polymer
Synthesis and Catalysis R&D
Reliance Research and
Development Center



Dr. Monalisa Swain
Frederick National Laboratory
for Cancer Research, Frederick
(FNLCR/NIH), MD, USA

10.00 – 10.30 AM	Invited talk **Dr. Narendra Kumar Tripathy** Director (Vice-President), API R&D, Emcure Pharmaceuticals Ltd, Pune	Introduction to Generic Drug Development
10.30 – 11.00 AM	Invited talk **Dr. Subhra Mohanty** Group Leader, Polymer Synthesis and Catalysis, Reliance R&D Center	Emerging Trends of Polymer Industry; Challenges and Opportunities in Polymer Industry
11.00 – 11.30 AM	Invited talk **Dr. Monalisa Swain** Frederick National Laboratory for Cancer Research, Frederick (FNLCR/NIH), MD, USA	Small Molecule Targeting for the Oncogenic and Viral Protein and Nucleic Acids (RNA & DNA)

Technical Session V: 11.30 – 01.00 PM
Session Chair: Dr. Sarat Chandra Das

Dr. Sarat Chandra Das
Reader in Chemistry, Salipur College (Retired)
Institute of Pharmacy and Technology, Salipur

Mr. Neelakamal Mohapatra
Vice President - R&D/ Innovation, Yansefu Inks, and Coatings Pvt Ltd.

Prof. Smrutiranjan Parida
Department of Metallurgical Engineering and Materials Science, IIT Bombay

Dr. Pranab Kumar Patra
Head, Process Innovation CreAgro, PI Industries Limited

11.30 – 12.00 Noon	Invited talk **Mr. Neelakamal Mohapatra** Vice President - R&D/ Innovation Yansefu Inks and Coatings Private Limited	Flexible Packaging and Allied Industries – A Lucrative Career Option for Odia Students
12.00 – 12.30 PM	Invited talk **Prof. Smrutiranjan Parida** Department of Metallurgical Engineering and Materials Science, IIT Bombay	Materials Trends for Future Applications
12.30 – 01.00 PM	Invited talk **Dr. Pranab Kumar Patra** Head, Process Innovation CreAgro, PI Industries Limited, Udaipur, Rajasthan	Crop Protection Chemistry

Panel Discussion Session: 01.00 – 01.40 PM

TOPIC: OCS-INDUSTRY INTERFACE MEET AS A STEP FORWARD FOR 'BACK TO SCHOOL' PROGRAM

Session Chairs: Dr. S. K. Biswal

Dr. Surendra Kumar Biswal

Chief Scientist, CSIR-IMMT, Bhubaneswar, PRESIDENT, 4MSI

PANELISTS

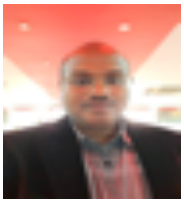
Prof. Ajaya K. Pattnaik

Professor of Chemistry (Retired)

Dr. Subhra Mohanty

Group Leader, Polymer Synthesis and Catalysis

Reliance R&D Center



Dr. Tapan K. Rout

Organizing Secretary OCS-Industry Interface Meet 2020

Dr. Rama Ch. Rout

CONVENOR OCS-Industry Interface Meet 2020

Prof. Sukalyan Dash

Professor of Chemistry, VSSUT, Burla

Dr. Pramod K. Satapathy

Professor of Chemistry North Odisha University, Baripada

Dr. Kumar S.K. Varadwaj

Associate Professor of Chemistry, Ravenshaw University, Cuttack

Mr. Neelakamal Mohapatra

Vice President - R&D/ Innovation, Yansefu Inks, and Coatings Pvt. Ltd.

Dr. Niranjan Panda

Associate Professor of Chemistry NIT, Rourkela

Dr. Amaresh Mishra

Associate Professor of Chemistry Sambalpur University, Sambalpur

Dr. Himansu K. Biswal

Associate Professor of Chemistry NISER, Bhubaneswar

Dr. Braja Narayan Patra

Associate Professor of Chemistry, Utkal University, Bhubaneswar

Dr. Bamakanta Gadnaik

Associate Professor of Chemistry Berhampur University, Berhampur

Dr. Bama Prasad Bag

Scientist, IMMT, Bhubaneswar

The participants can ask questions in the interactive window

Closing Function: 01.40 – 01.45 PM

01.40 – 01.45 PM	Closing remarks by President, OCS Announcement of Next OCS Event by the Secretary-cum-Treasurer, OCS Vote of Thanks by Dr. Debasis Mohanty, Co-Convener, FIRST OCS-INDUSTRY INTERFACE MEET 2020

For further details, please contact:

Dr. Debasis Mohanty, Co-Convenor, OCS-Industry Interface Meet 2020,
maildebasismohanty@gmail.com Phone: +919861391190

Dr. Priyaranjan Mohapatra, Secretary-cum-Treasurer, OCS,
priya_chem@vssut.ac.in, ocsindia.secretary@gmail.com Phone +919337046418

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About Orissa Chemical Society

The Orissa Chemical Society (OCS) is a non-profit scientific society registered under the Societies Registration Act, 1860. The Society, conceptualized in the School of Chemistry, Sambalpur University, was established in 1985 with late Professor Mahendra Kumar Rout as the founder president. The members of the Society are from diverse disciplines of chemical science. The society aims to enhance quality of teaching and research in chemistry in Odisha and popularise it among the students and the state's general public. Since its inception, the OCS has consistently grown in strength by attracting members from inside and outside the state, including overseas members. The Society organizes regular regional and annual conferences. For the first time, the OCS is organizing OCS-Industry Interface Meet, starting with the present international conference (webinar) on "Challenges and Opportunities in Making Industrial Research as a Career Option", in collaboration with Mining Minerals Metals and Materials Society of India (4MSI).

About 4MSI

4MSI, a professional society of two years old, is registered in Bhubaneswar. Over 200 personnel from different professions, such as, industrialist, academics, scientist, entrepreneurs and engineers are members. The objective is on promoting innovation, awareness on different technologies, scouting new technologies, extending help in new policy making, and providing a platform to students and entrepreneurs on breakthrough ideas. The Society has been organising national conferences on different themes as and when required and demanded. The members are striving to build relationships with different customers, government agencies and industry leaders ensuring proper management of resources for a better future. It has a knowledge post corner where anyone can subscribe for new ideas, information on mines, minerals and materials and the best technical presentations. 4MSI welcomes all members and non-members to participate in its technology webinar happening every month.

About the Conference on '"Challenges and Opportunities in Making Industrial Research as a Career Option"

The human society is in constant quest for a better living. Existing practices are being consistently refined and tuned to meet challenges faced from time to time. New materials and methods are being developed for creating better living conditions. Sustainable development necessitates a balance between material growth and the environment. Without a healthy ecosystem, human civilization would plunge into a massive crisis like the current COVID19 pandemic. New discoveries and inventions through innovative research in chemical sciences coupled with mass production using advanced industrial technology have provided solutions to various challenges faced by human Society over the last several decades. It is now realized that a career in industrial research is very challenging and highly competitive. However, there is a tremendous opportunity in diverse industrial sectors for new materials and advanced technologies. A career in industrial research is envisioned to provide ample opportunity to chemical scientist in not only building a rewarding career, but also can create employment for others. This international conference on '"Challenges and Opportunities in Making Industrial Research as a Career Option" aims to expose the audience to this subject. A number of technocrats and scientists of national/international repute will deliver talk on their industrial research and product development. Their success story will provide ample inspiration to the future generation of students.

Dr. Shashadhar Samal
PRESIDENT, OCS

Message

From the days of industrial revolution the human race continues to move forward in quest of a better life. Tremendous growth in technology through path-breaking innovations has made all aspects of human life a lot easier. The world is a lot more prepared to fight hunger and disease now than ever before. Technological advancement through rigours of research is the norm for sustained growth. Towards this end, input from both academic and industrial research bear equal importance. In fact, in many advanced nations, there is no defining boundary between industrial and academic research. Large industrial houses, through their own top-end R&D facility, continuously finetune the quality of their product through advanced research. University campuses are also vibrant with innovative research and hence compliment the needs of the industries.

The scenario in our country is no different. The nation is catching up with the developed countries very fast. Many state of the art research labs have come up under the ambit of both private and government support. In recent years, with the establishment of new national-level institutes and universities, Odisha is witnessing an unprecedented growth in higher education and research. These institutes of national importance with their excellent infrastructure and a vast pool of researchers are contributing significantly to chemical sciences. The R&D facility of industries are also being modernized with top-end analytical equipment. The OCS-Industry Interface Meet is being organized in collaboration with Mining Minerals Metals and Materials Society of India (4MSI) on 26th and 27th December in the form of an International Conference on "Challenges and Opportunities in Making Industrial Research as a Career Option". The meeting is the first of its kind in the OCS, and hence is of historic importance. A number of researchers from diverse industries and research institutes are invited to present their work. Their career journey and success stories would inspire and motivate the student participants to choose industry as a career.

I offer my sincere thanks to Dr. Surendra Kumar Biswal, President of 4MSI, and Dr. Tapan Kumar Rout, General Secretary, 4MSI, for this good gesture in collaborating with the OCS to hold the meeting. Many thanks to Dr. Rama Chandra Rout, who worked hard as the Convener to make the Meet a success. I congratulate Dr. Priyaranjan Mohapatra, Secretary-cum-Treasurer, OCS, Dr. Debasis Mohanty, Co-Convener of the Meet, and all the speakers for success of this historic conference.

Best wishes

(Shashadhar Samal)
President, OCS

Dr. Priyaranjan Mohapatra
Associate Professor, VSSUT, Burla
Secretary-cum-Treasurer, OCS

Vision of OCS-INDUSTRY INTERFACE MEET

This is a historic occasion for the Orissa Chemical Society. For the first time, the members of the OCS and research scientists from industry, those carrying out research in industry-sponsored projects, or involved in research that has relevance to the sector have come together onto a single platform. There has always been a need for such an interface meet, but it never materialized for one reason or another.

Every year, a sizable number of university graduates of the state find positions in industries. Some of them carry out research work relevant to the industry they serve. Over time, such researchers get de-linked from their parent educational institutions. Also, the parent institutions have not made any serious attempt to keep the alumni linked to their alma mater. Thus, there is a severe communication and collaboration gap between the researchers working in colleges, universities, and industries. This gap is most glaring in our state.

Unlike many advanced nations, industrial research, specifically in our state, is limited. Our industries are based on established technology, limiting research primarily to quality evaluation and control. Thus, such enterprises do not have severe needs to enter into any collaborative research, nor feel the need to support any basic research unless otherwise of direct relevance to the industry. The scenarios in other parts of the world are entirely different. Industries need to establish advanced R&D labs. For innovative products of diverse applications, enterprises need to invest considerable time and money in remaining competitive in quality and performance. Hence, the collaboration between industries and academia is intense and considered as the nerve centre for growth.

Fortunately, despite the limited opportunities, many of our alumni are engaged in industrial research. When the OCS communicated with some of them, there was overwhelming enthusiasm and interest to be a part of the OCS-Industry Interface Meet. In collaboration with the Mining Minerals Metals and Materials Society of India (4MSI), the OCS is organizing an online meeting on 26th and 27th December 2020 on "Challenges and Opportunities in Making Industrial Research as a Career Option". This meeting will remain recorded in the history of the OCS as the first-ever successful event to bring both the OCS and Industry onto a common platform. The speakers are highly experienced. I am sure the lectures will inspire the younger generation to opt for a career in industrial research.

Dr. Priyaranjan Mohapatra
Secretary-cum-Treasurer, OCS

Lecture 1

Alum from Aluminium Dross Rejects – A journey from Lab to Land

Bankim Ch. Tripathy
CSIR-IMMT, Bhubaneswar
Email: bankim@immt.res.in Phone: 79785 21730

Abstract

Aluminum dross is one of the major wastes generated from aluminum industries which contains a varied amount of aluminum values in the form of metals and metal oxide. Traditionally aluminum metal values are recovered and a tremendous amount of the rejects/residues containing 5-8% metal and 60-65% metal oxides are thus generated. A very small quantity of this dross residue is used for making crackers, impure chemicals, and low-quality refractory bricks. Disposal and recycling of the residue is a worldwide problem and most of which (about 95%) is landfilled due to the unavailability of suitable technologies for recycling. As the residue contains a lot of toxic substances such as nitrides, fluorides and in some cases also cyanides, it causes severe environmental pollution and contaminates the nearby water bodies destroying the local flora and fauna.

This process is an environmentally benign process that will utilize this aluminium dross hazardous residue to produce a high valued and highly useful chemical alum. This will completely abolish the mishandling of dross residues that causes severe environmental hazards. Based on our process M/s A.K. Entrepriser has put up the 1st dross processing plant of India in Khurda to produce alum (Figure 1). The plant has the capacity to process 5 tons of dross residue to produce 20 tons of alum per day. The plant was jointly commissioned and erected by M/s LN Indtech (An engineering company) and CSIR-IMMT, Bhubaneswar.

The alum produced in this process has the potential to treat the effluents from industries like leather, paper and pharmaceuticals etc. In addition to this, an industry of this capacity generates employment opportunities for about 20-25 people including engineers and chemists.

Figure 1. Snap-shots of the industry and the products.

Dr. Bankim Ch. Tripathy started his professional career as a Scientist at CSIR-IMMT in the year 2004. Presently he is working in the IMMT as a Senior Principal Scientist. He has over 20 years R&D experience in the field of extractive metallurgy, waste recycling and solid waste disposal. He has published more than 95 research articles in National and International journals. He has got 3 national and 2 international patents to his credit. He has guided 4 PhD students. Four international students from Cameron and Nigeria have been working under him as JRD Tata Postdoctoral Fellow, NAM S&T Fellow, TWAS Fellow with Sandwich Post Graduate Fellowship Award for their Doctoral Degrees. He is life member of many professional Societies in India such as OCS, IIM, IIME, IIChE, ISEAC, ASSET etc. He has visited many International Organisations as Visiting Professor, Mexico, Visiting Professor (Sir C.V. Raman Fellow), Canada, Postdoctoral Fellow, South Africa, and Postdoctoral Fellow, Australia. He was awarded Sir C.V. Raman Fellowship (2015) by CSIR – Visiting Professor and Raman Fellow (Canada) and NRDC National Meritorious Invention Awards of the Year 2019 under the category NRDC National Societal Innovation Award of the Year 2019.

Evolution of Aluminium Smelting and latest developments in Aluminium Smelters

Pratap Chandra Sahu

Hindalco Industries Limited
Email: pratap.s@adityabirla.com Mobile: 8018043267

Abstract: Aluminum production is one of the most energy-intensive industrial processes worldwide. Annual world aluminum demand is expected to increase two- to three-fold by 2050. The bulk of growth in consumption of aluminum will take place in China, India, the Middle East, and other developing countries, where consumption is expected to nearly quadruple by 2025 (Menzie et al. 2010). To meet this increased demand, production is projected to grow from approximately 51 million tonnes (Mt) of primary aluminum in 2014 to 89-122 Mt in 2050 (IEA 2012). This increase in aluminum consumption and production will drive significant growth in the industry's absolute energy use and CO2 emissions.

The Hall-Héroult Process

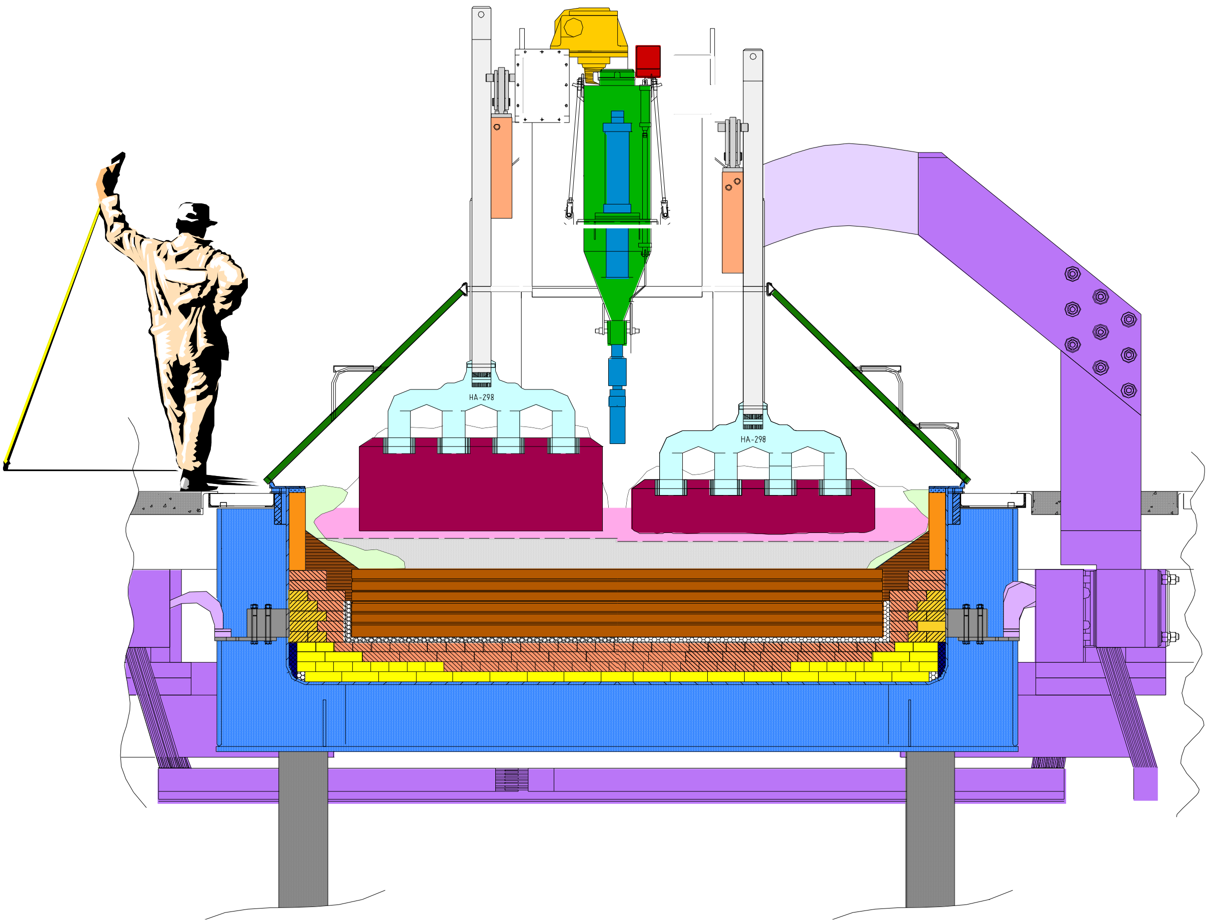
The Hall-Héroult process for electrochemical reduction of alumina to aluminum was first patented in 1886, and it is still the main method of aluminum production today. Electrolysis takes place in a Hall-Héroult cell, or pot, which is typically a shallow rectangular steel basin from 9 to 18 meters long depending on amperage, lined with carbon. In order to keep various materials molten, the cells operate at around 950-960 °C. Inside the cells, a molten cryolite (Na_3AlF_6) electrolyte or "bath" serves as the conductor for the electric current running through the carbon anode to the positively charged surface of newly formed molten aluminum on the carbon lining (the cathode). Aluminum fluoride (AlF_3) is added to the solution to maintain optimal chemistry and lower the electrolyte's freezing point. Beneath the carbon lining, steel bars pick up the electric current and take it to the next cell. Long rows of cells are connected in an electrical series (potline), sometimes up to around 400 cells per potline and more than one kilometer long. Automatic feeders continuously add alumina to cells, which dissolves in the molten electrolyte. As the electrical current passes through the solution, the dissolved alumina is split into molten aluminum ions (Al^{3+}) and oxygen ions (O^{2-}). The oxygen consumes the carbon in the anode blocks to form carbon dioxide. Molten aluminum produced at the cathode surface is regularly removed by siphon from the top of the cell. Electrolysis through the Hall-Héroult process is by far the most energy-intensive step of primary aluminum production, requiring about 13,000 kWh/ton (47 GJ/ton) in best-practice settings (Worrell et al. 2007).

Although the Hall-Héroult process was first developed over 100 years ago, it is still essentially the only commercialized production route for primary aluminum. The production of secondary aluminum from scrap and recycled aluminum is becoming an increasing source of the metal – in 2011, the amount of remelted and recycled aluminum approximately equaled the amount of primary aluminum produced (Tsesmelis 2013).

Over the last few decades, aluminium industries have been aiming for higher production volumes through capacity creep in the existing smelters with reasonable additional investment. However, a strong focus on specific energy consumption has always been part of technology considerations, and this aspect is even more critical today from the point of view of long-term sustainability.

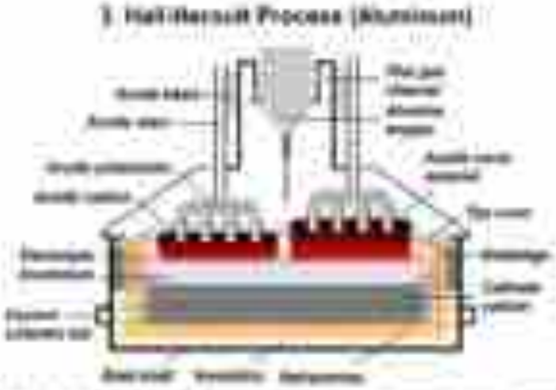
Introduction

The demand of aluminium is continuously increasing due to higher consumption in transportations, electronics, building construction and power. While recycling of aluminium is on the rise, primary production is still the major source of aluminium. Worldwide in 2018, primary production is expected to be 64 million tons as compared to 12 million tons through recycling route. The primary production has sustainable challenge from energy, solid waste and emission (CO_2 and PFCs) target. Compared to countries that use hydel power, countries like India that depend on coal-based generation, also face additional challenge of CO_2 emission from power generation.



For many decades, smelters have focused on developing cell with higher current for larger production volumes, while keeping the specific energy consumption low. However, due to ever-increasing power cost, the reduction in specific energy consumption has become more critical for many operations today. To mention, the cost contribution of electrical power in some countries further has increased by costs for indirect CO_2 emissions, or the limitation on production volume when availability of electric energy is limited by power production or grid capacity. The obvious response to these challenges is to lower the specific energy consumption of the primary production process.

The theoretical energy requirement to produce aluminium from alumina through electrolytic process using carbon anode is 6.4 kWh/kg of aluminium. For successful electrolysis, cryolite, the only electrolyte, which can dissolve alumina, needs to be maintained in molten state through Joule heating. Hence, the rest of the energy is required to maintain cryolite in molten state and to overcome other process instability. Over last few years, extensive research is going on to reduce this part of energy. From an average specific energy of 14.0 kWh/kg of Al, aluminium industries are consistently bringing down the energy through incremental design innovations aided by the refined control strategies and operational improvements. Rio Tinto Alcan (RTA),



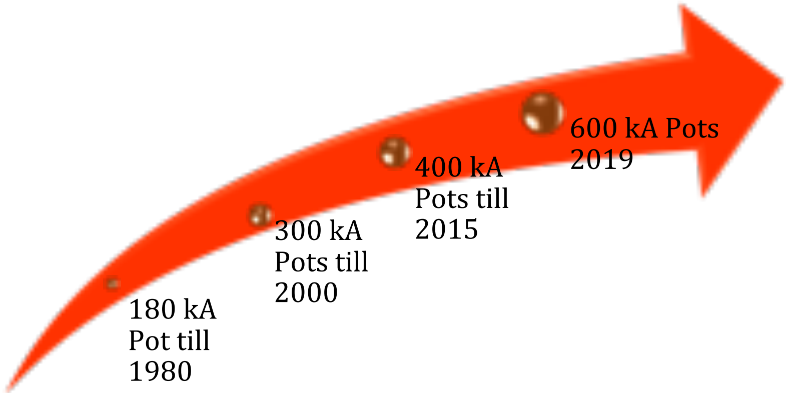
Hydro Aluminium (HAL) and Russian Aluminium (RUSAL) have been actively developing the cell technology, like AP-Xe, HAL4e ultra, RA-550, respectively, which offers benchmark specific energy consumption around 12.0 kWh/kg of aluminium. Few Chinese smelters have also reported cell technology running close to this benchmark energy consumption. The cell operation at such low energy will require innovation in design of anode, cathode, cell lining and bus bar configuration along with stringent process control to ensure alumina concentration in narrow band. Typically, advanced modelling, field measurements, smart sensors, advanced automations and test pot for trials are the platform for development of such technology. The article will present the current aluminium smelting technology and its improvements over the years through innovation in design, control and operational strategies for achieving the benchmark energy consumption.

Emerging Trend in Aluminium Smelting

Although the Hall-Héroult process was first developed over 100 years ago, it is still essentially the only commercialized production route for primary aluminum. The production of secondary aluminum from scrap and recycled aluminum is becoming an increasing source of the metal – in 2011, the amount of remelted and recycled aluminum approximately equaled the amount of primary aluminum produced (Tsesmelis 2013).

(a) Amperage Creep-up

In modern days, Smelters are increasing amperage to increase production Volume .New technologies are coming with higher amperage at the same time existing smelters are also increasing amperage to increase throughput. The amperage of an electrolytic smelter ranges from 60 kA to 600 kA depending upon the cell technology. The cells or pots are connected in series in a smelter by aluminium busbars, and DC current flows from one cell to another through these busbars. Within a cell, the current flows downwards through the carbon anodes, the molten electrolyte (cryolite), the molten metal (aluminium) and then to the carbon cathode blocks.



(b) Inert Anode Technology

Inert anodes can significantly improve the Hall-Héroult process for producing aluminum by eliminating the need for regular replacement of the carbon anodes currently used in Hall-Héroult cells. Ideal inert anodes are chemically nonreactive and are not consumed by the electrolysis reaction, and thus could ideally have the same lifetime as the smelting cell (Kvande and Drabløs 2014). Materials that have been considered for inert anodes include metals, ceramics, and cermets, a mix of these two.

In addition to eliminating the energy and material needs for frequently replaced carbon anodes, inert anodes can reduce the ACD in a Hall-Héroult cell, which as described in Section 2 is a major determinant of electricity used by the cell. Inert anodes could be easily installed retrofits in existing cells, with limited changes in smelter infrastructure. In addition, since regular access to the cells to change the anodes would not be necessary, the cells can be sealed more effectively to improve operating efficiency. Alternatively to a retrofit, inert anodes are also easily incorporated into new cell designs that use other technologies described below, such as wetted cathodes and low-temperature baths, all of which can further improve energy and environmental benefits.

A major barrier to designing inert anodes is finding cost-efficient anode materials that do not corrode significantly in the reaction solvent. Corrosion would not only mean that the anodes might have to be replaced more often than desired, but it would also add impurities to the aluminum produced (Kvande and Drabløs 2014).

The company INFINIUM is working on inert anodes sheathed with zirconium oxide (zirconia) tubes. The long-lasting tubes form a barrier between metal produced at the cathode and gas produced at the anode, preventing back-reaction and current leakage, and reducing harmful byproducts. The zirconia tubes would also expand the range of materials that could be used as an anode, possibly even holding liquid metal anode materials (INFINIUM 2013a). INFINIUM has already demonstrated the technology for magnesium, titanium, and rare earth metal production, and with funding for ARPA-E is working on adapting the technology for aluminum production (INFINIUM 2013b).

Rusal is developing inert anode technology both to be used as a retrofit for their current smelters, as well as in new greenfield projects, combined with other design improvements (Evans and Kvande 2008). Pilots were planned to begin in 2015. Alcoa has also piloted inert anode technologies at a multi-pot scale as of 2013, but technical and cost goals have yet to be achieved (AeroWeb 2013).

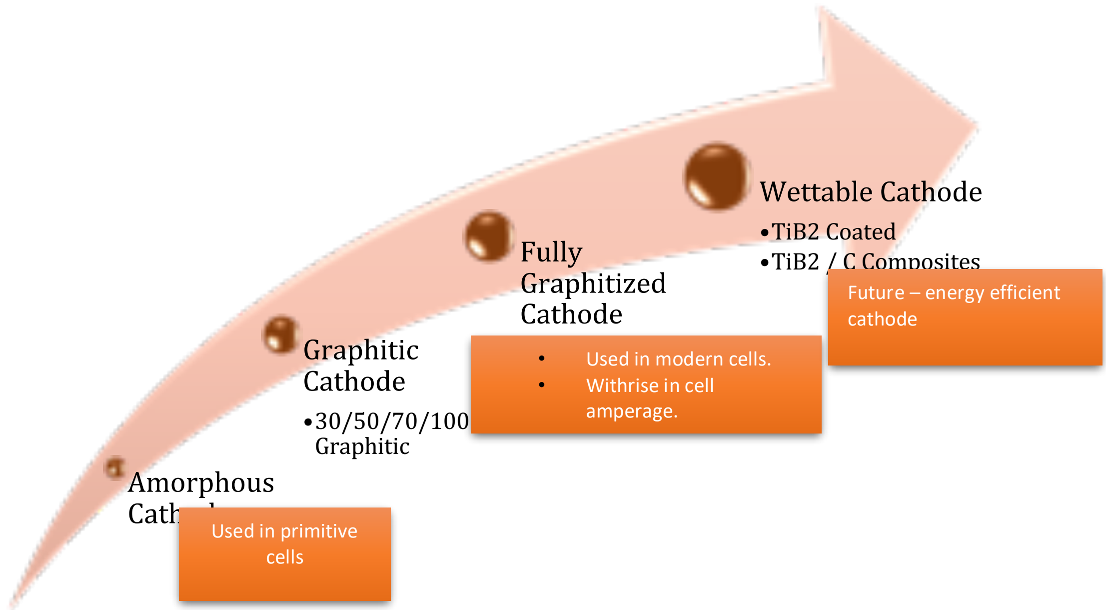
Energy/Environment/Cost/Other Benefits

Compared to conventional Hall-Heroult smelting with carbon anodes, inert anodes can have the following benefits: Energy savings of 3%-4% within a modified Hall-Héroult cell (U.S. DOE 2007) Reducing cost of production and replacement of the consumable carbon anode. Capital costs for inert anodes could be 10%-30% lower than that for conventional anodes (Thonstad 2001, Keniry 2001).Eliminating greenhouse gases produced by electrolysis with carbon anodes (CO_2, carbon monoxide, and PFCs) (Kvande and Drabløs 2014). Inert anodes produce oxygen instead. (U.S. DOE 1999).

Improving occupational health by eliminating the need to regularly replace carbon anodes in the smelting cells (Kvande and Drabløs 2014). Improving plant operating efficiency by eliminating anode effects (Kvande and Drabløs 2014) .For the INFINIUM inert anodes with zirconia tubes, reducing cell energy losses by 60% or more (INFINIUM 2013b).

(c) Evolution Cathode Material

A long lifespan of the aluminum reduction cell is required as cost factors are related to relining and loss of production time. The longevity of the cell at operating conditions is determined by the first material to fail inside the steel shell. There is significant development in cathode from amorphous grade to 100% graphitized grade has given smelters advantage to increase amperage and increase in productivity. Even Pot life also significantly improved. Recent development on CuCB has been widely adopted by smelters worldwide to enhance the MHD stability through reduction in horizontal current. Apart from improvement in MHD stability, CuCB also reduces the cathode voltage drop (CVD), attributed to uniform current distribution in the cathode and lower electrical resistivity of copper. The utilization of CuCB has demonstrated energy saving of about 0.3–1.0 kWh/kg of aluminium, depending on cell technology. Additionally, the cathode material with higher graphitization also reduces the CVD due to low electrical resistivity; however, it enhances the generation of horizontal currents. Increased height-to-width ratio of collector bar also reduces CVD, but enhances the generation of horizontal currents.

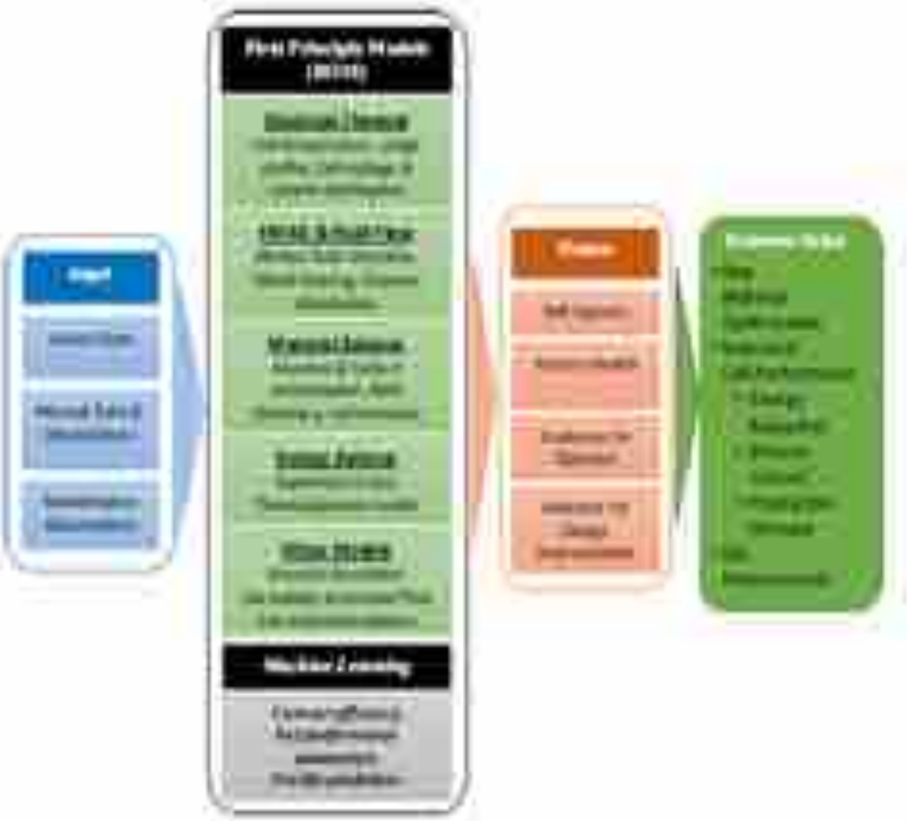


(d) Digitization in Aluminium Smelters

Over the decades, the sustainability of aluminium industry is principally ensured by improving the existing process with the aid of computers and automation. Aluminium smelting is a complex process, comprising production areas: power, material handling, carbon, reduction and cast house, operating as separate units, while remaining interdependent. Industry 4.0 introduces the concept of 'smart factory' in which computers and automation will come together in an entirely new way, assisted by smart sensors, internet of things, cloud computing, big data, machine learning and artificial intelligence. It can learn and control the process with very little input from human operators. In a digitally enabled smelter, operators are able to deliver more-efficient and precise operations, which can translate into a reduced energy cost, raw material economization as well as a lesser environmental impact. Digital twin (DT) is a digital replica of the aluminium smelter seamlessly integrated with the plant operation and control system leveraging the Industry 4.0 technology platforms as highlighted above. Based on real-time plant and process data, DT will continuously generate new data and insights into smelter performance forecast potential. The digital model of the smelter that runs in real time and forecasts performance is a key element of the DT. These digital models are based on design and operating information of the plant and process using historical and real-time data. Data analytic techniques, including machine learning, are generally used to build data-based models, which can be integrated with first principle-based models to enhance the robustness of these digital models remarkably. On successful incorporation, it will account for any unforeseen process deviations and in turn ensure high degree of reliability of DT. Reduced ordered model (ROM) technology is a fast emerging viable option to incorporate the first principle information in a real-time framework.

As shown in Figure below, DT will combine the data from various sensors/observations with the first principle-based model to depict the live pot condition. Use of artificial intelligence (AI) technology will enable creating a self-tuning live model of the smelters. Each pot/cell will be treated as individual asset for optimization of process parameters. This will serve as the foundation for various applications that contribute to the enhancement of the efficiency, productivity and reliability of the smelting process. Consistently monitoring variety of factors and utilizing the solutions of predictive analytics will enhance smelting process efficiency by lowering raw material's consumption, decreasing energy consumption and reducing pot leakages. DT can provide key intelligence on process variables such as temperature and compositions within the smelting pot, not ordinarily monitored continuously. When compared against the real-time data, it can spot actual or potential abnormalities and failures before they occur and provide real-time feedback to the operator. The insights empower operators to anticipate the health and condition of the pot and result in faster specific interventions, characterized set points for optimum operation and reduced losses from unplanned downtime or even major failures.

With the development and successful deployment across manufacturing industries, Industry 4.0-based technology solutions will be integral part of modern smelters and adopted by the existing plants in order to achieve sustainability goals and remain competitive.



Summary and Conclusion

The present aluminium smelters have been striving hard to bring down the energy consumption, which has helped them to remain competitive. Based on new developments in design modelling, measurement and control strategies, lining, anode and cathode materials and operational practices, the aluminium smelting plants are continuously improving energy consumption through various incremental innovations. Through step-change innovations in design, control strategies and operational practices, AP-Xe, HAL4e ultra, RA-550 have reached the benchmark specific energy consumption of about 12.0 kWh/kg of aluminium, at pilot scale. These cells operate at significantly low ACD of about 30 mm, which has been only possible through advanced modelling, field measurements, smart sensors and advanced automation. With the new developments in low-energy cell technology, the integration of heat utilization technology with efficient heat recovery system provides a great potential for further reduction in energy consumption. DCC and inert anode are two disruptive innovations that have been researched for a long time by academia and industries with a potential to retrofit in the Hall–He´roult cell. While there are pilot-scale demonstrations for both these technologies, full-scale commercial plant is yet to be established, largely due to higher operating cost and problems. For example, the longevity of electrode profile during operation, cathode materials, process control is still a challenge for DCC. Inert anode in vertical cell configuration has potential to reduce the operating cost by about 15% with increased productivity. However, inert anode technology retrofitted in the existing smelter, which utilizes coal-based power, may not be favourable to reduce the carbon footprint due to higher energy requirement for cell operation. With fast pace development in Industry 4.0 technology platforms (like internet of things, cloud technology, machine learning, artificial intelligence, etc.), digital twin will be a new disruptive technology intervention in aluminium smelting that will enable industries to achieve the highest level of operational and performance benchmark in energy and emissions.

References

1. Haupin W, in TMS Light Metals (1998) 531.
2. Grjotheim K and Kvande H, Introduction to Aluminium Electrolysis: Understanding the Hall–He´roult process, Aluminium Verlag GmbH, Du¨sseldorf (1993).
3. Becasse S, Martin O, Allano B, Caratini Y and Tinka D, in TMS Light Metals (2018) 699.
4. Mann V, Zavadyak A, Puzanov I, Platonov V and Pingin V, in TMS Light Metals (2018) 715.
5. Segatz M, Hop J, Reny P and Gikling H, in TMS Light Metals (2016) 301.
6. Naixiang F, Jianping P, Yaowu W, Yuezhong D, Jin Y and Xian'an L, in TMS Light Metals (2012) 563.

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Sri Pratap Chandra Sahu is serving as the General Manager, Head Potline Process Control, Mahan Smelter, Hindalco. He has vast experience in potline short circuiting test 2 smelters, commissioning, potline start-up, high amperage kA potline operation >367 kA, and standardizing parameters in high amperage potline. He has 19 years of work experience in Hindalco, Mahan Smelter, Hindalco, Aditya Smelter, ALBA, Bahrain, Balco (Vedanta), Korba, and Sterlite Copper, Tuticorin. Due to his exemplary service he was honored with 'Distinguished Achiever 2017 (Chairman Award)'. In addition to his professional qualification he is an MBA from Global NXT and a Master Black Belt.

Lecture 3

Ultra-purification of materials and their applications

Ratikant Mishra

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Ultra-pure materials play a key role in high-tech electronics such as integrated circuits, photovoltaic devices, optical elements etc. For example, Group III-V semiconductor, viz., GaAs is used in integrated circuits (ICs), semiconductors, LCD screens and InP is used in radiation detector, infrared devices, fibre-optics and infrared devices. High purity metals are employed for the production of special grade alloys with tuneable intrinsic properties. There is a huge demand for ultra-pure materials to meet the increasing requirements of electronic goods and technological developments. Due to commercial reasons, most of these high-tech materials are not freely available in the market. Each country has to develop its own technology and know-how for the large scale production of these materials. Synthesis of ultra-pure materials is quite challenging. It requires advanced technology, elaborate production facilities and extensive research inputs. A number of methodologies such crystallization, electrolysis, vacuum distillation, solvent extraction and zone melting are available for the synthesis of ultra-pure materials. In the present talk, we will discuss indigenous technological development for the synthesis some of the high-tech materials carried in our laboratories. Experimental details for the synthesis of ultra- pure germanium metal by zone refinement process, it's characterization by chemical and electrical property measurement methods and possible application will be discussed at length.

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Dr. Ratikant Mishra is the Head, Thermodynamics and Pure Materials Section, Chemistry Division, BARC, Mumbai. He did his M.Sc. in Chemistry from Utkal University in 1990, and Ph.D. in Mumbai University in 1999. He has 140 journal publications, and 5 Book Chapters. Two scholars have been awarded PhD degree under his guidance. His major field of research is chemical thermodynamics and high temperature chemistry.

Lecture 4

Fine & Specialty Chemicals Industry in India: Plethora of Opportunities

Rashmi Ranjan Mohanty

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As the whole world is looking up to India in the common fight against the deadly pandemic COVID 19, Indian Fine & Specialty Chemicals Industry sector is poised for a spectacular growth in coming years. China, no longer an attractive investment option due to clampdown on chemical manufacturing, global pharma majors are setting up shop or enhancing their manufacturing capabilities in India due to its large pool of scientific talents, cheaper production cost and liberal government support. Additionally, Government of India's Make in India policy, Atmanirbhar Bharat, and start-up-India initiatives have opened the door for unparalleled revolution in the sector by encouraging domestic SMEs and new-age entrepreneurs to cater to the burgeoning underlying demand from the end-user industries (including pharma), to seize outsourcing opportunities from the west and to develop import-substitute products (thereby lessening the dependency on export). ADVENT CHEMBIO PRIVATE LIMITED, since its inception in 2013, has been at the forefront to realize the dream of Atmanirbhar Bharat by working on innovative product ranges and chemistries and is on the verge of taking a leap to the new orbit with FDA approved, cGMP compliant, state-of-the-art pharmacopeial solvent manufacturing plant at Navi Mumbai to bolster emerging export opportunities and serve ever-increasing domestic need.

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Dr. Rasmi Ranjan Mohanty is the co-founder and Director-Technical, ADVENT CHEMBIO PRIVATE LIMITED - a leading Fine and Specialty Chemicals Manufacturer and Supplier, based at Navi Mumbai, Maharashtra. He did his M.Sc. in 1989 (Specialization in Organic Chemistry); M.Phil. in 1991; and Ph.D. in 1992-95 in Heterocyclic chemistry in PG Department of Chemistry, Utkal University, Vani Vihar under Prof. Satyaban Jena (awarded degree in 1999). He has 12 publications including 3 during post-doc period (in journals like Adv. Synth. Catalysis, Org. Lett. & Eur. J. Org. Chem. along with a European Patent on Asymmetric Synthesis of Chiral amines. He taught at Aeronautics College, Sunabeda, Odisha (1994-1997), and advanced chemistry to Chemical Engineering students at Thadomal Shahani Engineerong College, Mumbai (1997-2004). He was a post-doctoral research at IUB (International University Bremen, now called Jacobs University Bremen), Germany with Prof. Thomas Nugent (2004-2006) on Asymmetric Synthesis of Chiral Amines. He joined Ranbaxy Fine Chemicals Limited (later known as RFCL Limited) as a Manager, R&D in 2006, worked till 2012; worked on new products & process development, improvement of existing processes; Head-QA, QC & R & D in 2009 leading a team of scientists in Neosynth Division for development of Custom Synthesis products for discovery research in Pharma Industry; promoted to General Manager-Research Chemistry in 2011 and left the job in 2012. He is the co-founder and Director-Technical at ADVENT CHEMBIO PVT Limited since 01.01.2013. Driving Quality, Research & Innovation at ADVENT, he is also strategizing the new product launch and aspires to make ADVENT a global leader in the Fine & Specialty Chemicals segment. His fields of research interests are heterocyclic chemistry and chiral synthesis.

Lecture 5

Innovation in waste water treatment technology

Subhash Mallick

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Water and wastewater treatment are becoming very complex day by day due to the presence of a wide range of polluting agents and recalcitrant. Conventional treatment technologies are no longer very effective to meet the stringent environmental norms and water recycling standards. Many of the current treatment processes are highly chemical invasive due to the use of several high molecular weight synthetic chemicals. The life cycle of these chemicals in aquatic and associated ecosystems is not thoroughly investigated. In the present work, an advanced electrochemical and micro- and nanobubble-based non-chemical invasive technology called ELCOGEN™ is discussed. The ELCOGEN™ is based on a combination of electrochemical treatment, including advanced Electro-Coagulation (EC), Electro-Floatation (EF), and Electro-Oxidation along with micro- and nanobubble pre-treatment. The synergetic and powerful action of micro- and nanobubble, and electrochemical reactions treat all kinds of pollutants in one go without use of any synthetic chemicals. This non-chemical invasive technology is very fast, effective, of low cost, and high treatment capacity per unit area. The water recycle capabilities are very fast, effective, and meet most national and international standards. The ELCOGEN™ system can be used in almost all industrial wastewater/effluents and wastewater generated from medical, municipal, agricultural, domestic sewage, and raw waters.

Key Words: Electrochemical, Electrocoagulation, Electrooxidation, Micro- and Nanobubbles, ELCOGEN, Recalcitrant

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Dr. Subhash Mallick is M.Sc. and Ph.D. in Chemistry with 22 years of rich experience in Basic and Applied Industrial Research and Development in chemical, electrochemical (Aqueous, molten salt, non-aqueous, ionic), metallurgical (both hydro and pyro), waste utilization, pyrolysis, gasification, and environmental research which gives the diverse and wide range of skills that allow to contribute for the development of a variety of path breaking technologies & projects (developmental and production). Developed capability of managing cross functional scientific, business development and engineering manpower comprising of different levels and having wide network with various Industrial, Research groups. His expertise are in the fields of Electrochemical Science & Technology, Hydrometallurgical Processing (Beneficiation, Leaching, Solvent Extraction, Electro-wining, Molten salt and molten salt electrolysis, Carbochlorination, Pyrolysis, Process calculation and Basic Engineering Package, Design and Development of Electrochemical Process and Cells, Laboratory Management, Process Development, Technical Paper and patent writing, Project Management, Design and Scale up.

An Overview on Skill Set Requirements in Industrial Coating Segment for Next Decade - Research & Development in Paint and Coating Industry, a promising Career Option

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ABSTRACT

Technology plays very pivotal role in coating business and it has become a mandate for organizations to invest significant resources in R&D for business. Amongst coating technologies, the skillset requirements for R&D professionals are different for different areas within coating technology like, architectural coatings, industrial coatings. Industrial coating segment is more customer driven and customer oriented and the R&D operations need more time-bound deliverance. Selection and recruitment of R&D professionals in different coating segments is hence very crucial and has impactful effect on coating business revenue.

1. INTRODUCTION

The first line of defence between the facility and the environment is the main attribute of paint and coatings. The Indian paint market which was around Rs. 40,300 crores in 2014-15 was predicted to reach Rs. 70,875 crores in 2019-2020. The domestic paint industry is estimated to be a Rs 500 billion industry with the decorative paint category constituting almost 75% of this market as per a Paint Sector Analysis Report dated 22 January 2020. Industrial paints in India is estimated to be at about $1.9 billion as per Coatings World, September 2020. The decorative paint market includes multiple categories depending on the nature of the surface like exterior wall paints, interior wall paints, wood finishes, enamels as well as ancillary products like primers, putties, etc. The industrial paint category constitutes the balance 25% of the paint market and includes a broad array of segments like automotive coatings, marine coatings, packaging coatings, powder coatings, protective coatings and other general industrial coatings. Unlike decorative paints, the industrial coating segment is more capital intensive and requires a strong corporate relation to run the business.

Research and development (R&D) in paint industry typically focuses on applied research to develop projects that meet the company goals and support the business plan of the company. Industrial research on the other hand differs from academic research as it deals with systematic investigation into a problem or situation, where the intention is to identify facts and/or opinions that will assist in solving the problem or dealing with the situation. The basic difference between professional research and academic research is shown in Table 1.

Table 1

ACADEMIC RESEARCH	PROFESSIONAL – R&D IN INDUSTRIES
Also called Scholarly research	Also called Applied Research/Professional Research
Seeks to add to a larger body of knowledge	Seeks to find solutions to instant problems and issues
Conceptual questions, theoretically focused	Practical questions
Study results publicized/published	Organizationally focused, Study results kept private

Professional research can be defined as the research work done to advance an individual's profession and focuses on research goals that emerge from business requirements.

2. RESEARCH & DEVELOPMENT IN PAINT & COATING INDUSTRY

Research and development (R&D) in paint and coating industry includes activities that companies undertake to innovate and introduce new products and services. R&D in paint and coating industry is important for businesses because it provides powerful knowledge and insights, leads to improvements to existing processes where efficiency can be increased and costs reduced. It allows businesses to develop new products and services to allow it to survive and thrive in competitive markets. The strategic role of R&D can be segmented as shown in Figure 1.

Figure 1. Strategic Role of R&D

R&D for existing business ensures the business that are able to compete and to exploit all available opportunities. R&D to drive new business ensures the business that is continually on rise and ensures these business can be exploited. R&D for exploratory research ensures understanding of new technology that the paint or coating manufacturer can invest in for existing business or business growth. R&D department or section in coating/paint manufacturing organization holds a very important role in the organizational model and R&D operations form the foundation of all operations in a paint manufacturing organization and are directly linked with the operations of other departments or sections like: (a) Sales, (b) Technical Services, (c) Supply Chain, (d) Marketing, and (e) Production (Figure 2).

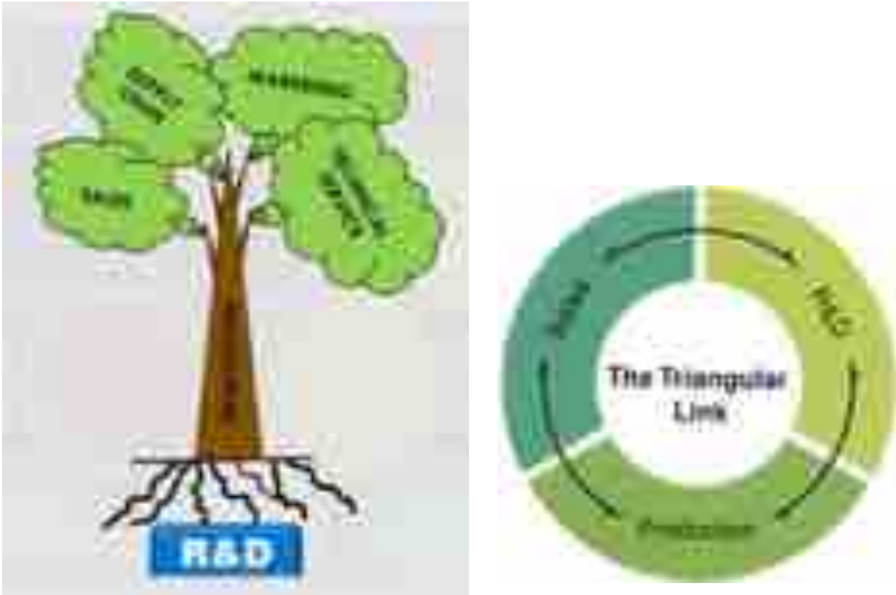

Figure 2. R&D department or section in coating/paint manufacturing organizations.

3. CHALLENGES IN RESEARCH & DEVELOPMENT IN PAINT/COATING INDUSRTY

Overall, the coatings industry is experiencing healthy investment in R&D driven by a number of factors, including increasing environmental regulations, growing customer expectations for more improved sustainability, growing competition and cost pressures in mature economies, and growth of emerging markets. To meet the expectations and achieve set targets in terms of revenue, R&D team in paint and coating industry need to perform and deliver with efficacy and to meet the targets R&D professionals need to overcome the challenges during the course of R&D operations. A promising R&D professional in paint industry has to fulfil the following demands:

a. Voluminous development efforts to meet ever growing and changing requirements
b. High level of innovation, focus on core competencies and collaborations
c. Development of new markets, and enhanced pressure on the market because of prices
d. Time-bound troubleshooting ability, flexibility and quick responsiveness
e. Deliverance of cost effective and timely solutions

The major difference in R&D operations with different sections like decorative and industrial coatings is the need of the respective market. Industrial coatings require more customer specific operations and a significant part of industrial coating R&D professional work profile has to deal with attendance of product trials, resolving issues during line of application in addition to development of new products as per market requirement and changing market trend, product upgradation, process upgradation and product testing. Aesthetic feasibility trends along with functionality such as insulation, adhesion, wettability, moisture control, UV resistance, corrosion resistance, or wear resistance for decorative products and decorative coating research and development operations focus on both aesthetic feasibility and functionality.

4. OPPORTUNITIES & SKILLSET REQUIRMENT IN RESEARCH & DEVELOPMENT IN PAINT/COATING INDUSRTY

Research and development in paint industry is abundant in opportunities and based on the academic qualifications and credentials of the R&D professional, he/she can excel and grow in every aspect of his/her career. The opportunities or work profiles within R&D in paint/coating industry can be broadly distinguished as shown in Figure 3. Based on academic qualifications and skills of R&D

professionals the work profiles/roles can categorized in paint/coating industry R&D as: (a) Roles based on Strong Academic Qualifications, and (b) Roles based Experience and Skill with Moderate Academic Qualifications (Figure 4).

Figure 3. Various opportunities in paint/coating R&D.

Figure 4. R&D activities based on Academic Qualifications

Skillset is a major attribute for a R&D professional in paint/coating industry for his/her performance ability and is wholly responsible for effective functioning of R&D. The skillset requirements for R&D professionals in paint/coating industry is as follows:

a. Strong subject background
b. Trained in basic research laboratory
c. Ability to work as part of a multidisciplinary research team
d. Analytical thinker and critical problem solver
e. Excellent time manager with the ability to work Independently
f. Good oral and written presentation skills
g. Sincere attitude towards work
h. Skilled in interpersonal communication
i. Basic computer knowledge
j. Passionate learner

Figure 5. Academic criteria for R&D professionals in paint/coating industry.

The academic qualification of R&D professional plays a pivotal role in the growth of the paint/coating organization as the performance of R&D directly reflects the growth of paint/coating organization and performance of R&D solely depend on performance of R&D professional. The academic criteria for R&D professionals in paint/coating industry can be comprehensively and pictorially represented as shown in Figure 5.

5. CAREER GROWTH PATHWAY IN R&D IN PAINT INDUSTR

Career path is a structured timeline with short and long-term benchmarks in an organization and maps the route a professional take from a lower-level position through successive occupations to arrive at an ultimate goal in his/her career. The career growth pathway for a R&D professional in paint/coating industry at different entry levels in R&D depending on academic qualifications and experience trend can be depicted as presented in Figures 6 & 7.

Figure 6. Career growth pathway in R&D in paint industry.

Figure 7. Stage wise career growth as per experience trend in R&D in paint industry.

As applicable in every profession the career growth in R&D in paint/coating industry is wholly dependent on the individual's performance and contribution to the growth of the organisation. Also, exceptional performances consequently can lead to exceptional trend in career growth.

CONCLUSION

Research and development in paint/coating industry is a promising career for individuals with research aptitude. Broadly classified as decorative and industrial coatings, the R&D operations, the skillset for R&D professionals based on the segment of paint/coatings differ as the market differs and business approach differs. Academic credentials and skill credentials are of equal significance for a R&D professional in paint industry. A successful and insightful R&D professional always have the option to set foot into others departments in a paint/coating manufacturing organization like vendor development, technical services and sales; as a good background in R&D is always an attribute to excel in other departments as R&D works in close knit with these departments in the organization. To conclude, as in every profession, the right career choice in R&D in different segments of coating technologies is solely dependent on one's interest and knowledge base and a sincere and passionate learner will always excel in this profession.

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Mr. Chinmaya Chandra Nayak started his career as a Technical Trainee at ICI paints in 1998. He joined Berger Paints as Technical Executive in R&D Department and left as Section Head, Protective coatings. Presently he works in Shalimar Paints as Head R&D industrial. He has 22 years of experience in product development, technology implementation, technical support, and training. Mr. Nayak did M.Sc. in Physical Chemistry from Delhi University, and did his MTech in Corrosion Science and Technology.

Career Opportunity on Natural Products - Its Discovery, Standardization, and Marketing

Baidyanath Mishra

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ABSTRACT

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Dr. Baidyanath Mishra is a Senior Research Scientist with more than 20 years of experience in sophisticated research techniques and technologies in natural products that includes Ayurveda, Nutraceuticals, cosmetics and wellness sectors. He has expertise in lab and field research and he is well-versed in implementing quality control procedures and assisting with creation of research protocols. He did his Ph.D. in HEALTH CARE from Sri Chandrasekharendra Saraswathi Viswa Mahavidyalaya University (SCSVMV). He is an MD in AYURVEDA from Calcutta University and MS in AYUREDA from Sambalpur University.

Lecture 8

Introduction to Generic Drug Development

Narendra Kumar Tripathy

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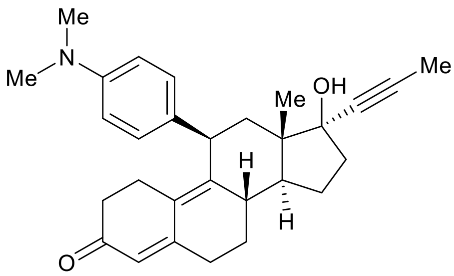
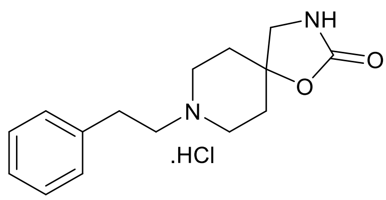
Phone: 9370130046

This lecture is on development of generic drugs focusing on API process research on two molecules: RU-486 and Fenspiride Hydrochloride.



RU-486 (Mifepristone)



Fenspiride HCl

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Dr. Narendra Kumar Tripathy is working as the Director (Vice-President), API R&D, Emcure Pharmaceuticals Ltd, Pune. After completing MSc (Org). from Utkal University, Dr. Tripathy joined the group of Padma Bhusan awardee Dr. A V Rama Rao, Ex-Director at IICT, Hyderabad for pursuing PhD in the area of synthetic organic chemistry. His research work includes total synthesis of critical fragments of complex natural products such as anti-HIV complestatin and chloropeptin and well known glycopeptide antibiotic vancomycin. He did his post-doctoral studies at Rutgers University, NJ, (1999-2001) and University of Kansas, KS (2001-2003). At Kansas, he worked with Prof. Gunda Georg (current editor-in-chief of JMC) in SAR studies of anti-cancer cryptophycin and taxol derivatives. Prior to moving to the USA, he spent about a year (1998-1999) as Research Associate at NCL, Pune, developing novel processes for anti-hypertensive generic drug celiprolol. On return to India in 2003 he joined Sai Life Sciences, Hyderabad (CRO) as a Principal Scientist. After spending about four and half years, he moved to Emcure Pharmaceuticals, Pune (2008, Mar) to start a career in API, Research and Development. Over the past 13 years at Emcure, he has gained experience in various areas of API development and manufacturing with a number of domestic/regulatory filings and commercialization. He has 12 publications (4 Tet. Lett./8 OPRD) and 30 patents. One student has been awarded PhD degree under his guidance and one more is writing his PhD thesis.

Lecture 9

Emerging Trends of Polymer Industry; Challenges and Opportunities in Polymer Industry

Dr. Subhra Mohanty

Polymer Synthesis and Catalysis R&D, Reliance Research and Development Center
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Fourth Industrial Revolution is on its way where physical, biological and digital periphery is amalgamating with each other. Everything is digitized and connected through Internet of Things (IOT). Speed of all the processes are becoming very fast including the most cumbersome material processes due to digitization, IOT etc. Material science is also not left far behind. Most of the material synthesis and process are also digitized and technologically advanced. In this context Polymeric materials are emerging out as a promising alterative material for 4^{th} Industrial revolutions. Be it Biological, digital or as a physical material, polymeric materials are taking the lead due to its flexibility, conductivity and biodegradability. In this growing segment of advance material, plethora of opportunities are there in material development, application, manufacturing testing etc. We will discuss in detail during presentation. But challenges are also multi-fold in this segment of material due to its poor biodegradability. We will discuss more details during our future discussion.

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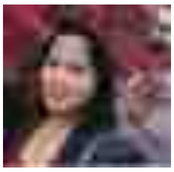

Dr. Subhra Mohanty is presently serving as the Group Leader, Polymer Synthesis and Catalysis R&D, Reliance Research and Development Center. She did her MSc in Chemistry from Utkal University in 1992 and PhD in Rubber Technology from IIT Kharagpur in 1997. She has 15 journal publications, 10 reviews, and 15 patent. Her fields of research interests are development of novel polymers and elastomers, polymer blends and composites

Lecture 10

Small Molecule Targeting for the Oncogenic and Viral Protein and Nucleic Acids (RNA & DNA)

Monalisa Swain

Frederick National Laboratory for Cancer Research, Frederick (FNLCR/NIH), MD, USA
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ABSTRACT

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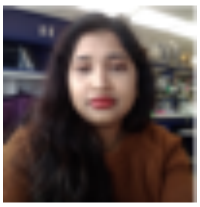

Dr. Monalisa Swain now works as a scientist at FNLCR/NIH, USA. She did her MSc at Utkal University, Vani Vihar (2003-2005) and Ph.D. at Indian Institute of Science (IISc), Bangalore (2006-2011). She obtained Ph.D. from the Department of Solid State and Structural Chemistry Unit (SSCU) and NMR research center (NMRC) under the supervision of *late* Prof. H. S. Atreya. The title of her Ph.D. thesis is 'Structural and Functional Studies of hIGFBP-2 by NMR, and Biophysical Studies of Protein Nanotubes'. At the end of 2011, she moved to Department of Chemistry, Yale University, USA for post- doctoral research. In 2014 moved to National Institute of Health (NIH) for another post- doctoral research at the Department of Structural Biophysics Laboratory (SBL). Now she is employed as a scientist in the NIH. She has 12 published research articles and one book chapter. Her research interests include **s**mall molecule targeting for the oncogenic and viral protein and nucleic acids (RNA & DNA).

Flexible Packaging and Allied Industries – A Lucrative Career Option

Neelakamal Mohapatra

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ABSTRACT

This presentation provides a comprehensive synopsis about flexible packaging and how this sector has been turning into a lucrative career option for students or new comers who wants to make potential future in rapidly growing industry. The global flexible plastic packaging market size is projected to grow from USD 160.8 billion in 2020 to USD 200.5 billion by 2025, at a CAGR of 4.5% from 2020 to 2025. Industries including, Printing Inks & Coatings, Packaging films, Lamination Adhesives & Packaging are expected to witness significant growth in the future due to its increased demand in end-use industries, such as food, beverage, cosmetic & personal care, and pharmaceutical. As these industries emerge, the number of career options will proportionally increase. A brief description about all these industries related to flexible packaging is provided. The purpose of this presentation is demonstrate the wide spectrum of career opportunities available in flexible packaging industry.

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Mr. Neelakamal Mohapatra presently serves as the Vice President - R&D/ Innovation, Yansefu Inks and Coatings Private Limited. He did his M. Tech. in Chemical Technology from HBTI, Kanpur, India. He is a R&D, IPR and Product Safety Regulation personnel with 21 years of research experience in the Printing and Packaging sector. He focuses towards developing cutting edge products and processes for Flexible Packaging application. He has worked in various capacities with renowned printing ink, coating and adhesive manufacturing, and IPR organizations such as Sakata Inx, Scitech Patent-Art, Uflex Chemicals, Siegwerk India Pvt. Ltd. and currently working with Yansefu Inks and Coatings Pvt. Ltd in the position of Vice President-R&D/ Innovation. His research work has been published in journals of national and international repute. Few of his innovations has also been patented. He has 30 publications and 16 patents registered on his name. His special interest in promoting product safety regulation (PSR) within printing inks and food packaging industries have been well acclaimed by various organizations. He has actively supported BIS Committee to revise & draft the Indian standard IS 15495:2020 for inclusion of chemicals such as Toluene, Titanium Acetylacetonate and Phthalates to restrict their use in printing ink formulations for food packaging. He is well-versed in establishing R&D and Innovation culture; taking In-house R&D approval from Government of India; Printing Ink formulation development; Polymer Synthesis; Alternate Raw Material development; Patent Protection; Product Branding, Competitor's product mapping; Set-up of High-end analytical laboratory and production facilities; Conducting seminars; Providing trainings to Channel Partners & customers and many other skills. In addition to Indian Flexible packaging Market, he has global exposure towards product and market know-how of overseas flexible packaging markets including Germany, France, Indonesia, China, Malaysia, Thailand, US, Taiwan and Mexico.

Materials Trends for Future Applications

Smrutiranjan Parida

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Materials are key to technology development. High-performance materials are required to increase the product value and economy of the implementation. Nanotechnology along with novel processing methods has a major contribution to produce materials with unique morphology, structure, and properties, which are required to realize incomparable functional properties for different applications. On the other hand, the unique structure also determines how these materials interact with the atmosphere, which determines their performance and life. Such environmental interactions and economic considerations must be factored in the development and use of a given material for a specific application.

The research on the development of materials with novel, advanced properties from the field of electrochemical energy and smart coatings has continuously endeavored to establish the intricate relations between materials processing, structure, properties, and performance. A summary of the recent development in the new materials in these fields will also be covered.

Electrochemical energy storage: The increasing energy demand has triggered tremendous research efforts for the development of lightweight and durable energy storage devices. This requires exploring suitable active materials, and their simple, economical methods of preparation and then the design of lightweight, flexible, free-standing supercapacitor electrodes in an inexpensive binder-free process. Therefore, various forms of carbon and oxide materials and their combination have been explored. In this context, carbon nano-onions (CNO) and its composite with CuO as active materials have been studied.[1] The carbon nano-onions (CNOs) or onion-like carbon consisting of multiple concentric graphitic shells (Figure 1) to form encapsulated structures are an important member of the fullerene family.[2] CNOs have been envisioned to be a promising supercapacitor electrode material with high power density due to nonporous outer shells.[3] In a symmetrical two-electrode supercapacitor device, a pristine CNO electrode delivers a specific capacitance of 102.16 F/g (20 mV/s), the energy density of 14.18 Wh/kg and power density of 2448 W/kg, which are the highest values reported so far for CNO based materials. CNO-CuO nanocomposites demonstrate very significant specific capacitance of 420 F/g (10 mV/s) with deliverable energy and power density at 58.33 Wh/kg and 4228 W/kg, respectively. Electrodes of both the active materials show excellent cyclic performance and stability, retaining up to 90-95% of initial capacitance after 5000 charge-discharge cycles at a current density of 5 A/g. A simple cost estimation indicates that our device can deliver an energy density of 58.33 Wh/kg at an estimated cost of less than one dollar.

Similarly, asymmetric high voltage asymmetric supercapacitor (ASC) fabricated using porous CNO-ZnO composite negative and ZnO as a positive electrode (CNO-ZnO//ZnO), achieved high electrochemical performance.[4] An optimized ASC demonstrated a stable operating voltage window of 0 – 1.8 V with a maximum deliverable specific capacitance of 125 F/g, a high energy density of 14 Wh/kg and a power density of 2375 W/kg. Besides, an excellent long cycle life with 92% specific capacitance retention after 2000 cycles was possible in CNO-ZnO//ZnO ASC device. As compared to their constituent symmetric supercapacitor, the optimized hybridized nanostructured ASC shows a significant improvement in both energy and power density.[4]

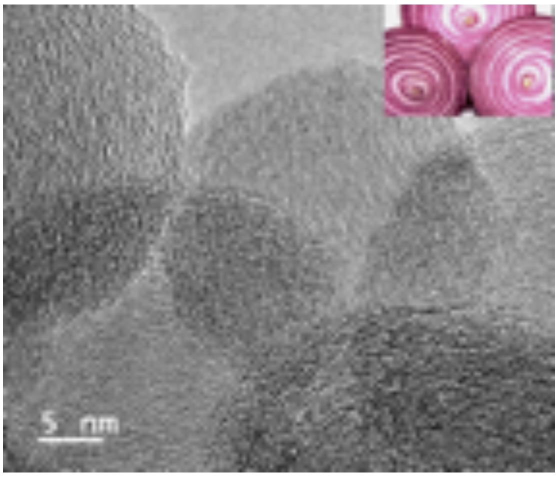

Figure 1 The microstructure of carbon nano-onions (CNOs) or onion-like carbon consisting of multiple concentric graphitic shells, mimicking an onion.

In another strategy towards engineering, pristine carbonaceous materials for supercapacitor applications, doping of heteroatoms, such as nitrogen (N), and sulfur (S) into the carbon matrix of CNO was carried out. The N doping induces a positive charge in adjacent carbon, while sulfur acts as an electron donor and the lone pairs of electrons on S enhances the local reactivity of S-doped carbon; all these effects enhance the pseudocapacitive response. The highly graphitic, mesoporous nitrogen-doped carbon nano-onions (N-CNOs) were prepared by a one-step in situ flame pyrolysis procedure.[5] The operating voltage of the fabricated ASC device using N-CNO is extended to 1.8 V in a 1 M Na_2SO_4 electrolyte, yielding a maximum specific capacitance of 113 F g^{-1} and a high energy density of 51 Wh kg^{-1} at a high current density of 4 A g^{-1}. Importantly, even at a high current density of 20 A g−1, the device still delivers a high power density of 18 kW kg−1 while maintaining a high energy density of 6 Wh kg−1. Furthermore, the novel ASC exhibits excellent electrochemical reversibility and cyclic stability over 10,000 cycles, retaining 98% and 99% of its specific capacitance retention and coulombic efficiency, respectively, at a high current density of 20 A g−1. The smaller characteristic relaxation time-constant (340 ms) as compared to the previously reported graphene/MXene-based supercapacitors, validates the ultrahigh-rate ASC device-performance.[5]

On the S-doping in CNO, (S-CNO), showed a specific capacitance of 305 F g^{-1}, the energy density of 10.6 Wh kg^{-1}, and power density of 1,004 W kg^{-1} at an applied current density of 2 A g^{-1} in a symmetrical two-electrode cell configuration.[6] At a deliverable power density of 2.5 kW kg^{-1}, the S-CNO//S-CNO device showed an energy density of 8.08 Wh kg-1. A high degree of electrochemical reversibility with excellent cycling stability, retaining ~95% of its initial capacitance after more than 10,000 repetitive charge-discharge cycles at an applied current density of 5 A g-1 was also achieved.[6]

A comparison chart of the CNO, N-CNO and S-CNO is presented in Figure 2a-c, showing significant improvement in the electrochemical performance due to heteroatom doping, which is a very good indicator for the supercapacitor application.

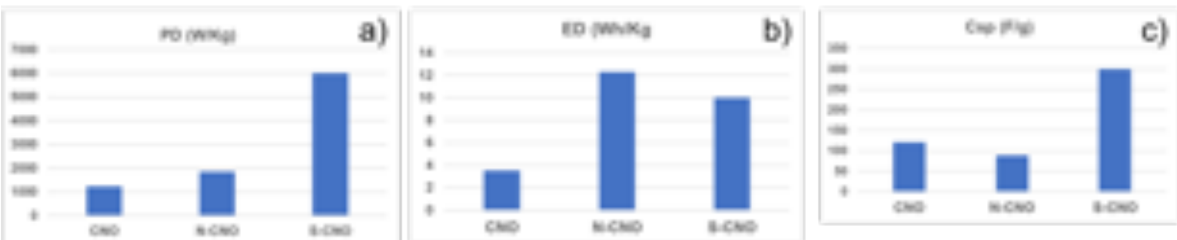

Figure 2 Comparisons of a) power density, b) energy density and c) specific capacitance of the CNO, N-CNO and S-CNO.

Smart coatings: Materials degradation is one of the major challenges to the lifecycle of materials used in health, electronics, social and industrial infrastructures. In a recent report, it is predicted that an overall corrosion loss is 4.2% of the gross domestic product of India.[7] Such loss is detrimental to the environment and long-term sustainability. Surface coatings are one of the best and economical solutions to the environmental degradation of materials. However, to increase the value of the product the coating needs to have multifunctionality and responsiveness to the hostile environment. The coatings with the latter properties are called self-healing coatings. Various nanomaterials are also used to reinforce the coating matrix to attain better protective and mechanical properties.[8,9] The self-healing property in coatings is achieved by the use of encapsulating inhibitor and polymeric healing agents in a smart encapsulant, from where the healing agent slowly releases in response to the damage. The nano or micro containers with the core-shell structure are used to release the healing materials at the damaged site in a controlled manner in response to the mechanical damage, the pH, and temperature change (Figure 3).

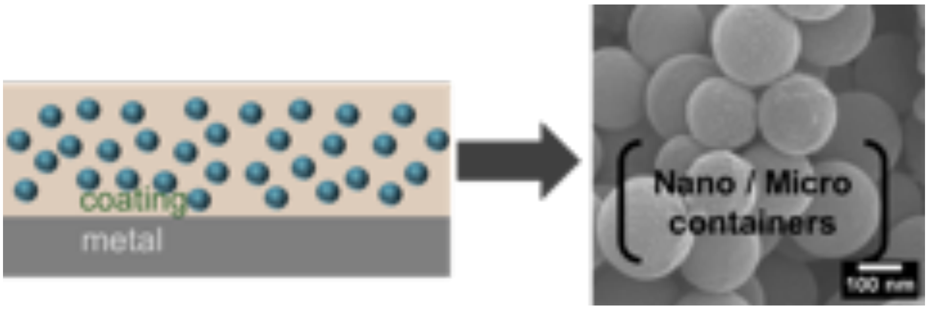

Figure 3 Micro-/Nano-containers embedded in the coating matrix impart self-healing property to the smart coatings.

These examples in materials design for advanced application are indicators of manipulations of hierarchy in the structures to achieve better functional applications. Scaling up of these studies must consider performance under real-world conditions and economics.

References

1. Debananda Mohapatra, Subramanya Badrayyana and Smrutiranjan Parida*, RSC Advances, Vol.6, 2016, pp.14720-14729.
2. D. Ugarte, Nature, 1992, 359, 707–709
3. Debananda Mohapatra, Subramanya Badrayyana, Smrutiranjan Parida*, Materials Chemistry and Physics, Vol.174 :, 2016, pp.112-119
4. Debananda Mohapatra, Smrutiranjan Parida*, Subramanya Badrayyana, Balwant K. Singh, Applied Materials Today 7 (2017) 212–221.
5. D Mohapatra, O Muhammad, MS Sayed, S Parida, JJ Shim; Electrochimica Acta 331, 2020, 135363
6. Debananda Mohapatra et. al.; ACS Appl. Mater. Interfaces 2019, 11, 8, 8040-8050
7. NACE Impact study, 2016.
8. Daradmare S, Pradhan M, Raja VS, and Parida S (2016), J Mater Sci 51:10262-10277. doi:10.1007/s10853-016-0254-4.
9. Daradmare, Sneha; Raj, Sunny; Bhattacharyya, Arup R; Parida, Smrutiranjan; Composites Part B: Engineering 155, 2018, 1-10

Dr. Smrutiranjan Parida works as a Professor in the Department of Metallurgical Engineering and Materials Science, IIT Bombay. He did his M.Tech. in IIT Kharagpur in 2002, Ph.D. in the Faculty of Natural Sciences and Technology, University of Saarlandes, Saarbruecken, Germany in 2007. He has 50 publications, 1 patents, wrote a Book Chapter and a review. Five students have been awarded PhD degree working under his guidance. His fields of research interests are nanomaterials, electrochemical energy, and smart coatings.

Lecture 13

Crop Protection Chemistry

Pranab Kumar Patra

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In the last six decades, agriculture development has mainly focused on improvement in crop varieties, modern irrigation methods, and new chemicals, including pesticides and fertilisers. These technologies continue to be very relevant and beneficial to agricultural productivity. In recent years, however, there have been many reasons for the need to improve the strategies of using these technologies as well as to search for new tools. There are several reasons - why improved strategies and new tools are essential - 1) Development of pest resistance to many pesticide modes of action; 2) Limited supply and development of new synthetic chemical modes of action; 3) Increased interest in using alternative products; 4) The need for more food to feed the ever-increasing world population. Thus, developing chemicals to protect agricultural crops is an important activity in chemical industry. Some of these chemicals, the insecticides, are also very important in combating human and animal diseases. Research aims to produce chemicals that are not just potent but are specific for the required purpose, whilst not affecting the environment in any other way. Because pests may develop resistance to crop protection chemicals there is a continual need for new products to be developed. There are mainly three group of chemical pesticides - Insecticide, Herbicide and Fungicide. I will present an overview of the pesticides, and their chemistry.

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Dr. Pranab Kumar Patra is presently serving as the Head Process Innovation CreAgro, PI Industries Limited, Udaipur, Rajasthan. Dr. Patra did his M.Sc. at Sambalpur University in 1991, and Ph.D. at North Eastern Hill University and IIT Kanpur in1997. He has 23 journal paper publications; 9 published patents and 4 patents have been filed. His fields of research interests are Organic Synthesis, Homo and Heterogeneous Catalysis, Material Chemistry, Discovery Chemistry, Scale up and Process Research.

Panel Discussion

TOPIC: OCS-INDUSTRY INTERFACE MEET AS A STEP FORWARD FOR 'BACK TO SCHOOL' PROGRAM

Discussion Summary

1. Prof. A. K. Patnaik said that the curriculum should be overhauled from the school levels to include courses on Industry Chemistry and the environment. In the present 4 + 4 + 2 system, one of the vocational courses should be on Industrial Chemistry. To this, Dr. Priyaranjan Mohapatra said that VISSUT, Burla has M.Sc. in Industrial Chemistry. Nevertheless, it was agreed upon that the earlier Industrial Chemistry in the B.Sc. should not have been scrapped.
2. Responding to the general notion that research in the academic institutions has no industrial application potential, Prof. Patnaik narrated specific research findings in the Department of Chemistry, Ravenshaw University, such as the development of a procedure for the production of biodiesel, new electrodes for the production of hydrogen from water, and new drug substitutes from quinine, etc., which have ample industrial potential. Industries need to come forward for commercial exploitation of these processes.
3. Dr. Subhra Mohanty believed that the present generation of students heavily relies on the digital platform as a learning resource. However, actual textbook reading is far more beneficial. So, the students should devote more time to reading textbooks. This reading habit will help them to assimilate research literature later in their academic career. Lack of reading habits led many students to not knowing even the existence of research papers. School is the right place as a starting point. In colleges, there should be frequent interactions with the research scientists and, more specifically, those from the industries. At this stage, they should visit industries and should do industrial project works.
4. Several participants also were of the opinion that students are becoming poor on communicative English. They should be frequently asked to give a presentation in the department seminars in English.
5. For the teachers, it is essential that they should be encouraged to attend Refresher Course. In these courses, there should be courses on Industrial Chemistry.
6. Dr. Rama Chandra Rout said that our society now requires strong motivation, starting with the parents. It is seen that most parents do not have much interest in their children pursuing science as a career, let alone applied sciences. There should be similar training for the teachers, so that, apart from teaching, they can demonstrate through their research the rewards of being a scientist.
7. In this regard, Dr. Rout questioned the participants from the industries for supporting motivated faculty and students. Dr. Tapan Kumar Rout responded that the Institute of Chemical Technology got funding from Reliance Industries. Similarly, there is a District Mineral Fund, which supports Engineering Colleges in Keonjhar District and other colleges of the district.
8. Prof. Pramod Kumar Satpathy said that it is not that students are not interested in pursuing basic science. These days, the trend is getting reversed. Good students are coming to doing Hons and PG in Chemistry. The number of students opting for basic science is too large, making the selection process a challenge.
9. He suggested that NAAC strongly emphasizes on Academia-Industry collaboration, the importance of industry-sponsored research, and curriculum enrichment in this direction. Experts from Industries should frequently visit academic institutes and address seminars.
10. These experts also could guide M.Sc. students in their project work conducted in the industries. It is frequently seen that the M.Sc. dissertations are copies of review articles. A review article should not be a dissertation!

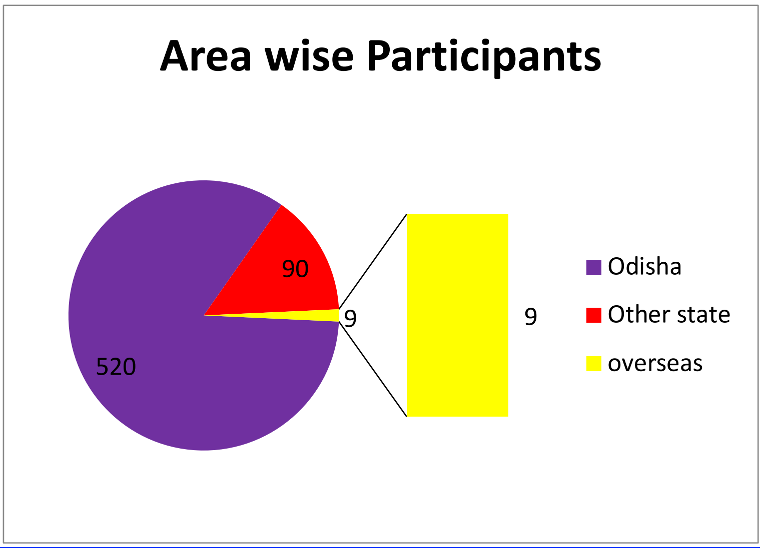
11. Mr. Neelkamal Mohapatra stated that the rest of the world is surging ahead. It is time that we in India, and particularly in Odisha, should act now without waiting for the Govt. initiative. The relationship between Industry and Academia is a two-way process. In general colleges, there should be placement cells. Networking is important. The students should venture out of the state for on-the-job training in industries. He also invited students to take this training at the cost of the industries. Successful completion of training could fetch lucrative jobs in industries. Many students need the support of trained young personnel. Analytical instrument training helps students getting an industrial job relatively easily.
12. Dr. Amaresh Mishra emphasized that the industry-academia interface meet is a great step forward in the right direction, and irrespective of the outcome, such meets should be continued.
13. Dr. Himansu Sekhar Biswal said that alumni with a successful industrial career should be invited for inspirational talks. Such lectures should be arranged by the industries in basic science institutes. He also emphasized the importance of students from basic science institutes visiting technical institutes for exposure to analytical equipment.
14. These endeavors must start right at the school level, said Dr. Braja Narayan Patra. It is crucial to motivate the students early, as we lose most students for technical education at the +2 level. To retain students to pursue basic science and move onto an industrial/R&D career, attractive experiments should be carried out at the school level. After graduation or even post-graduation, Dr. Patra pointed out that many students are opting for banking, thus wasting vital resources and time. There should be more experiments at the graduation level on industry requirements. Industrial chemistry practical should be in the curriculum. Projects should be industrial projects.
15. Dr. Bamakanta Gadnaik stated that there is a significant shift in career choice in the last decade. In 2010, technical education was the primary choice. Over the years, there is a clear shift for basic science education. The faculty strength should be maintained in colleges and universities to attract quality students to basic science education.
16. Dr. Bama Prasad Bag pointed out that there are ample opportunities in advanced research. For example, he said that there is a constant need for organic materials for diagnostics sensing applications. He believed that ‘Unemployability’ is a western word. Anyone at any basic level of education can be employed through proper training. Currently, in the schools, a program called ‘Jigyansa’ is being undertaken. OCS can move to IMMT for similar programs in colleges.
17. Dr. Tapan Kumar Rout stated that between industry and academia, there should be a common goal. It is vital for academia to create an environment for industry to be interested in academic research. There should not be any ego factor, and there should be mutual trust. The lab should allow access to the results of the experiments to the industries supporting such research.
18. Dr. Prakash Sahu (Sai International) said that OCS should include schools in its programs for motivational talks and lab visits.
19. It was felt that in the future, some students should be included in the panel discussions.

Social Media & Technology Used

Host Platform	**Zoom**
Live streaming	**YouTube & Facebook**
Information	**Facebook page, WhatsApp group and Email**
Registration, Attendance and feedback	**Google form**
Certificate	**Google slide & Certify'em**
YouTube links (click the links for replay of the Live Stream)	**Day 1** https://youtu.be/vSWvEBkveW **Day 2** https://youtu.be/XZuxQwXN0xg
Facebook Page	**Department of Chemistry, Dhenkanal (auto) College Dhenkanal link-** **https://www.facebook.com/groups/801857737040959/**
WhatsApp Group	**First OCS Industry meet- link-** https://chat.whatsapp.com/IQodvRtDsv5LfGEhFjdsai

Statistics

	Participants	Speaker
Total	619	13
Indian	610	11
Overseas	9	2
Odisha	520	3
Other state	90	8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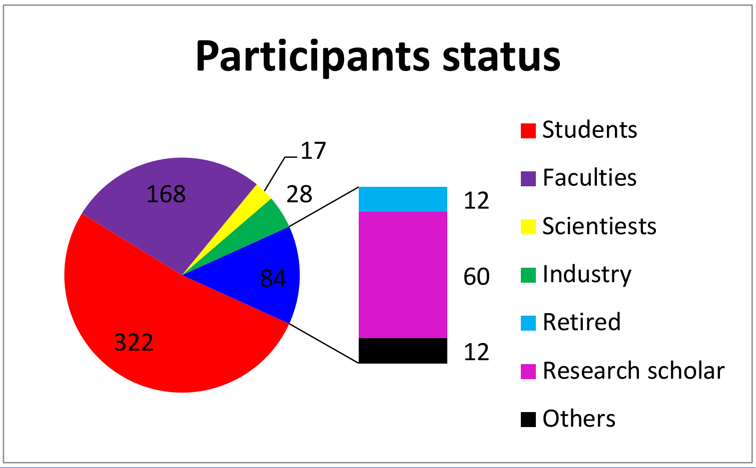
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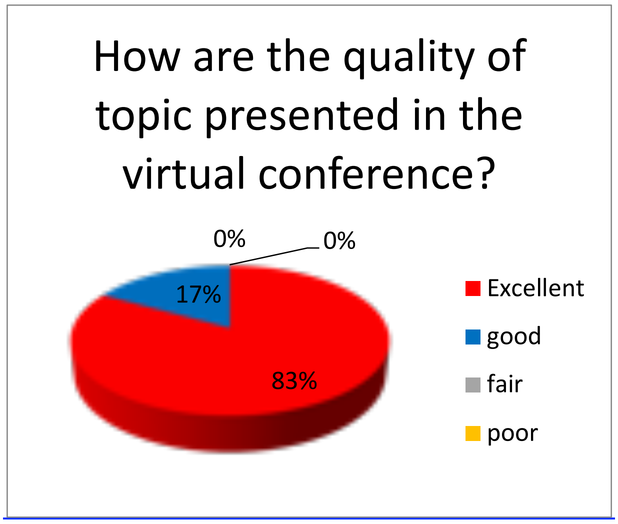
Retired
Research scholar
Others

FEEDBACK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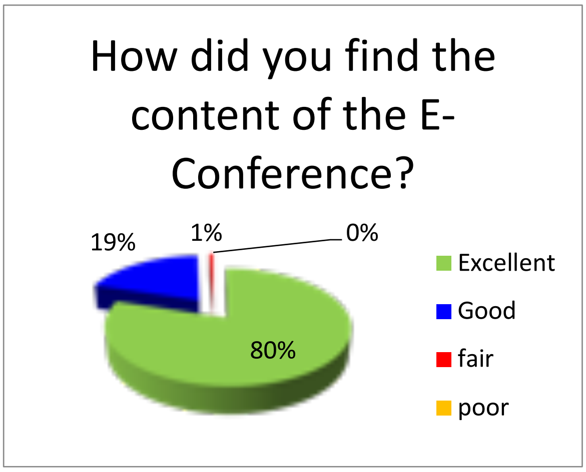
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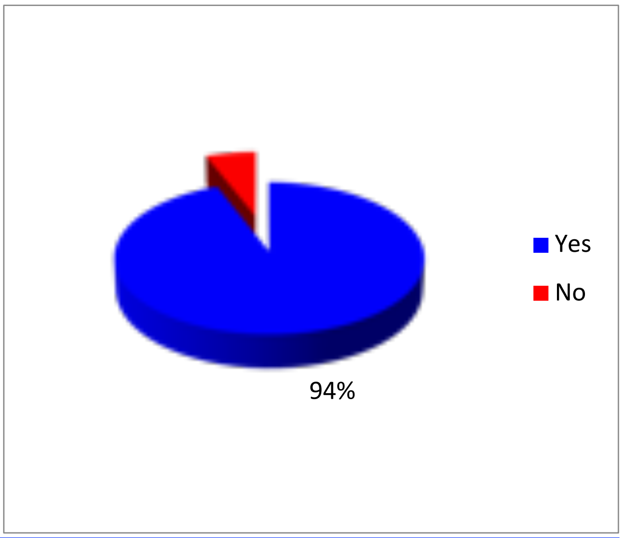
Yes
No
94%

Glimpses of the Webinar