Nigerian Chemical & Engineering Industry MAGAZINE

A Four-Monthly Publication of Nigerian Society of Chemical Engineers

(A Division Of Nigerian Society Of Engineers)

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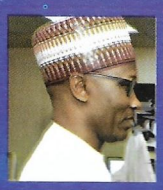
CHEMICAL ENGINEERING SOLUTIONS TO HUMAN CIVILIZATION

• The Zeolitic Dimension



Mr. Mele Kyari
NNPC GMD

NSChE Delegates Visit GMD, NNPC

Safe Use of Cooking Gas

Prof. Ahmed

Chemical Engineering & Info Tech

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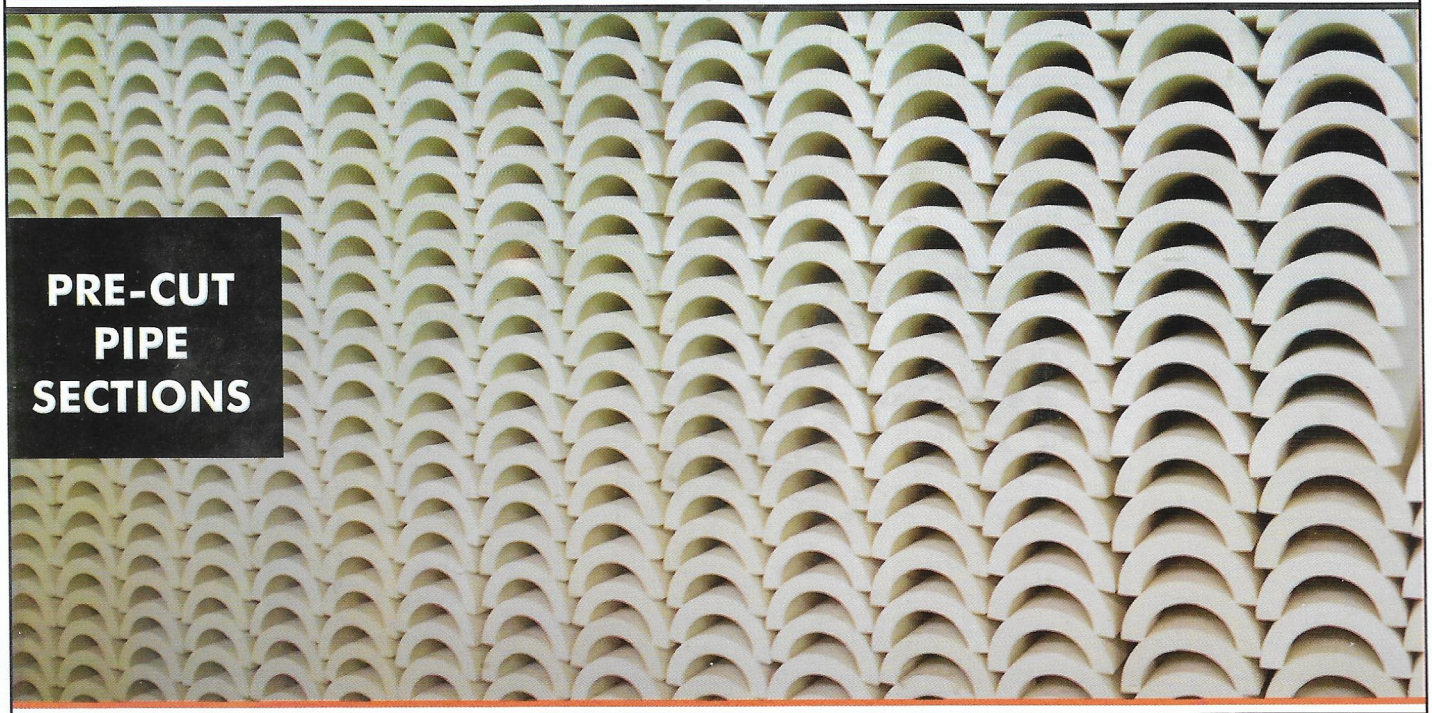

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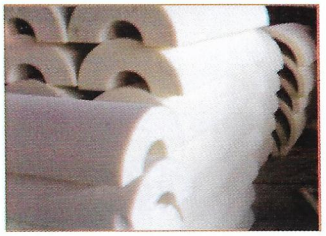

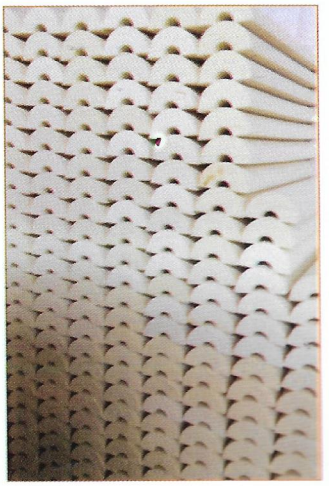

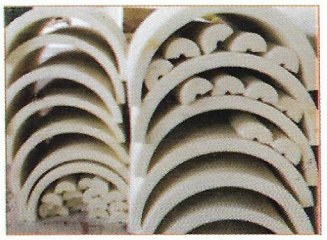

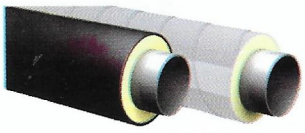

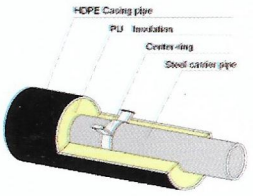

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NSChE VISION

"To be the Center of excellence for the Chemical Engineering Profession in Africa and the Prime Mover of Industrialization in Nigeria".

NSChE MISSION

"To organize the Nigerian Society of Chemical Engineers into a virile professional body capable of promoting the relevance and versatility of the profession, achieving better training and updating of Chemical Engineers through its activities. Fostering of relationships with the academia, research institutes, industries, other professional bodies and government will be the basis for stimulating accelerated industrialization of the country and improving the quality of life of the Nigerian people".

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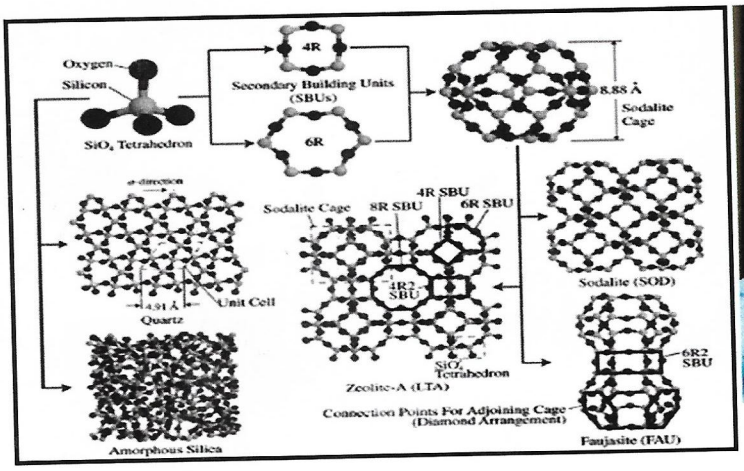
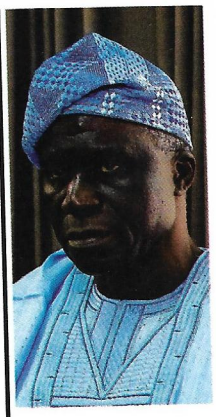
Contents

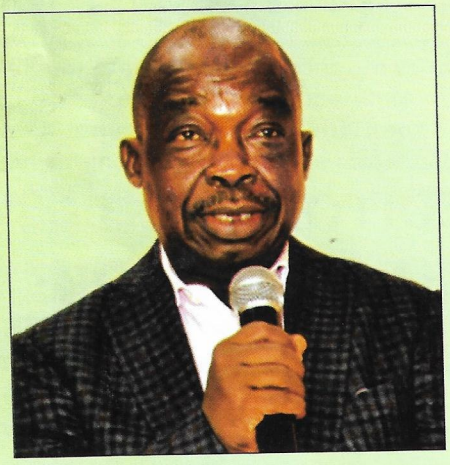
CHEMICAL ENGINEERING SOLUTIONS TO HUMAN CIVILIZATION





Prof. Adefila

- The Zeolitic Dimension **10**



NATIONAL PRESIDENT'S MESSAGE **05**

SUSTAINABLE ENERGY AND OUR ENVIRONMENT **27**

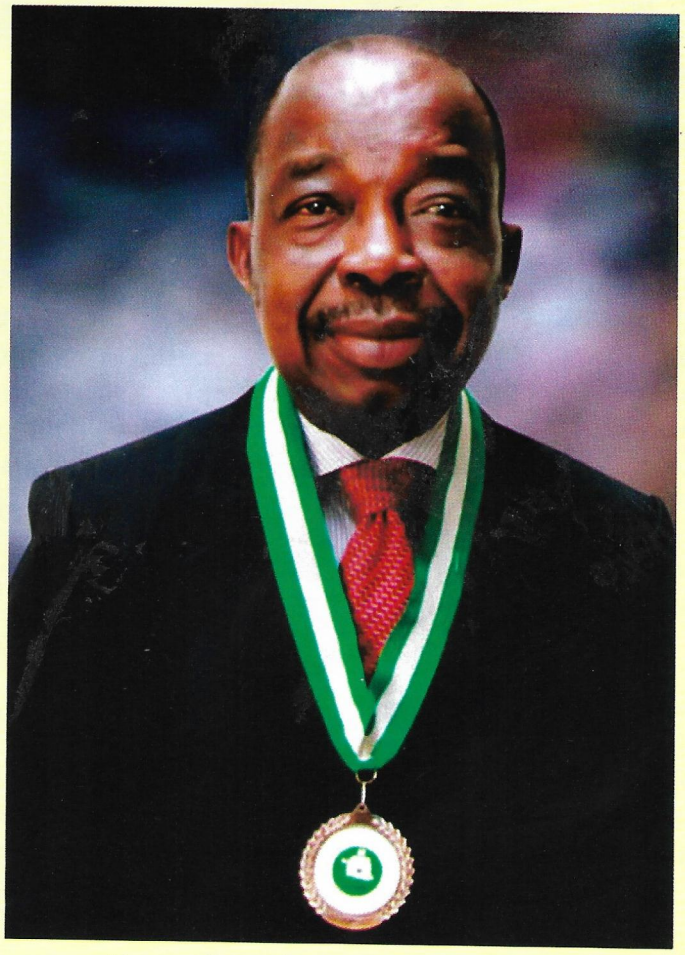
SAFE USE OF COOKING GAS **27**

PICTURES OF NSChE VISIT TO THE GMD, NNPC

NATIONAL PRESIDENT'S MESSAGE

With profound pleasure, I announce the arrival of a truly engaging Industry and Engineering practice magazine from Nigerian Society of Chemical Engineers (NSChE).

The is intended to meet not just the needs of practising Chemical Engineers in the industry, academia and government, the language and structure should attract interest and clientele from a broad spectrum of stakeholders.



Engr. Onochie Anyaoku, *FAEng*
(National President, *NSChE)*

It will feature industry products, processes, technologies, business models and commercial breakthroughs not just for advertisement purposes but also for enhancing knowledge and demonstrating local capabilities.

Coming on the heels of the rejuvenated website for NSChE and rekindled focus of the Society to provide evidence-based inputs into government Policy Green papers, it is one of several initiatives aimed at making NSChE responsive to the needs of members. The magazine will also encourage members and other engineering practitioners to focus on finding solutions to myriad and near-debilitating challenges confronting our country and showcase same in a manner that triggers a critical mass of solutions providers. The magazine will encourage our practising members to develop critical communication skill of writing quality articles that address technical,technology and policies in a most impactful manner. They will surely find pleasure in contributing to the magazine once wide readership and acceptance by the stakeholders are achieved.

In addition to addressing areas of process operations, technology, entrepreneurship, and environment (HSE), the magazine should serve as a veritable platform for robust discussions of policies that affect industrial development of Nigeria and collecting feedback from stakeholders.

Industries and equipment vendors shall be encouraged to advertise products and services. It is my hope that the editorial structure of the magazine will promote vibrant intellectual exchange that truly enriches knowledge in a manner that promotes continuous learning and professional development to NSChE members.

"The magazine will also encourage members and engineering practitioners to focus on finding solutions..."

Thanks
ENGR. ONOCHIE ANYAOKU, *FAEng*
(National President, Nigerian Society of Chemical Engineers)

FROM THE Editorial SUITE

***Engr. Donatus Uweh**, MNSChE*
(Editor-in-Chief)

It is with great delight that we are presenting the maiden edition of NSChE magazine. Clearly our desire is to present to our readers an engaging, interesting, educative and informative magazine. The contents would be seen as having engineering underpinnings but by and large, the general public has a lot to learn from this new entry into the magazine segment of the media sector.

Our cover story on "Application of Chemical Engineering Solutions to Human Civilization: The Zeolitic Dimension" by Prof. Sam Adefila, FAEng has set the ball rolling in this maiden edition.

Chemical Engineering entails the conversion of raw materials into usable finished products. At the factory level, the core activity of processing is managed at the production units which have linkages with the overall factory management involving personnel, accounts e.t.c. At the industrial level, the core activity of production at various factories is linked to the national economy involving key players, particularly captains of industry and the government.

Today, China as a country, has been converted into a huge production hub which explains why its economy is booming and it is now an envy of many nations. This understanding should serve as a boost in getting key decision makers in Nigeria to take Prof. Adefila's work on zeolite seriously and put the machinery in motion to deploy the material to boost our industrial capacity and economy.

The paper by Prof. Adefila was delivered on May 23, 2019 at Presken Hotel, Ikeja, Lagos to mark the 88th birthday of Engr. Anthony Olufemi Shobo, FAEng. This was a suitable opportunity to bring to public understanding the link between Pa Shobo's role model status in advocating for industrial advancement of Nigeria and the novel work on zeolite by Prof. Sam Adefila geared towards our country's industrial development.

Human safety and the safety of plant and equipment are paramount in operating factories. This is not a new concept but NSChE is spearheading a move to take safety practice to a new level. In the Executive Secretary's column, readers will get to know how our Society is going about it and the status of this initiative.

We are also pleased to serve our readers with the article on "Sustainable Energy and our Environment" by Dr. Godwin Udoh, FNSChE. This is another way of saying that planning for the future should start today as far as energy matters as they affect the Nigerian economy is concerned.

Housewives including industrial users of cooking gas, technically referred to as liquified petroleum gas (LPG) will find the piece on "Safe Use of Cooking Gas" by Mr. Ayo Aiyede quite enlightening. It is not too much to talk or read about Safety because life is precious.

This is Information and Communications Technology (ICT) age. In this edition, Prof. A. S. Ahmed shares his knowledge in this respect in the article "Chemical Engineering Education and Information Technology".

The key visits made by NSChE delegates are presented in memorable pictures. One of the visits was the one made to the Group Managing Director of NNPC, Mr. Mele Kolo Kyari by NSChE delegation led by the National President Engr. Onochie Anyaoku, FAEng. The other visit is the one made to the Council for Regulation of Engineering in Nigeria (COREN).

It is also pertinent to inform our readers that NSChE's 49th Annual Conference/AGM is scheduled to hold at Hotel Seventeen, Kaduna from 13th – 16th November on the theme "Enhancement of Agricultural Value Chain for Economic Development: The role of Chemical Engineering". All chemical engineers in Nigeria should endeavour to attend.

As a Society, we are very pleased to serve our teaming members and the public with this maiden edition of our magazine.

We deeply appreciate all those who have contributed to making this publication successful.

Happy reading!

NSChE SPEARHEADS THE FORMATION OF 'NIGERIAN PROCESS SAFETY INITIATIVE' AS A NON-PROFIT ORGANIZATION

1.0 INTRODUCTION

Following the Bhopal tragedy that occurred on December 3, 1984 in which more than 5,000 deaths were recorded in India (according to the figures released by government),the American Institute of Chemical Engineers (AIChE) formed the Center for Chemical Process Safety (CCPS) in 1985 as an industry alliance to share and enhance process safety expertise in industry.

Through the efforts of CCPS, Process Safety has since gained corporate importance and extended into the general skill set of chemical and petroleum engineers and operators, and many industry-wide guidelines for process safety have been developed.

Today CCPS is the leading global exponent of Process Safety and has its reaches and footprints all over the world (North America, South America, Europe, Asia/ Pacific), perhaps with the exception of Africa.

***Sam O. Bosoro**, MNSChE*
(Executive Secretary, NSChE)

Nigeria has also suffered severally human and material losses arising from disasters that occurred in process plantswhich could have been prevented if necessary care were taken or at least reduced to the barest minimum.

The formation of Nigerian Process Safety Initiative.(NPSI) by NSChE was borne out of the compelling need for process industries to imbibe the culture of operating under safe conditions by putting in place standard policies and operating guidelines as doing so guarantees their continued existence and reduces to the barest minimum the possibility of a disaster occurring.

"Today CCPS is the leading global exponent of Process Safety and has its reaches and footprints all over the world (North America, South America, Europe, Asia/Pacific), perhaps with the..."

OBJECTIVES OF NIGERIAN PROCESS SAFETY INITIATIVE

The main thrust of NPSI will be to foster knowledge and best practices in Process Safety in the Oil & Gas and Process Industries in Nigeria, leveraging on the experience and success of CCPS.

The key objectives shall be to:

- Create strong awareness of Process Safety in the Oil & Gas and Process Industry Sectors
- Consistently highlight compelling need for commitment to safety culture for all industry practitioners
- Engender sharing of best practices amongst all players in the sectors
- Advance and deepen Process Safety knowledge and best practices
- Assist to close Process Safety gaps in the industry
- Drive implementation of Process Safety Management Systems and strict adherence to regulations and standards
- Spearhead the inculcation of Process Safety in undergraduate and graduate curricula in relevant technological disciplines
- Equip lecturers and academics in the relevant disciplines with

the vital knowledge and skills required to instruct the students

- Enhance the competencies of industry practitioners in Process Safety on a continuing basis
- Provide a collaborative platform for interfacing with the global Process Safety community.

2.0 STRUCTURE OF NIGERIAN PROCESS SAFETY INITIATIVE

NPSI shall be a fully registered non-profit organisation in Nigeria, anchored by NSChE, and supported by the collaborative participation of oil & gas, petrochemical and process industry companies, organisations and stakeholders, which represents a model that has consistently delivered success in the area of industrial safety in many countries of the world.

This initiative would bring together manufacturers, consultants, contractors, government agencies, academia, researchers, insurers, etc, for the purpose of improving and deepening Process Safety in the country.

Funding for the programs and activities shall be from the participating organisations. Funding may also be obtained from multilateral agencies and international donor organisations interested in Process Safety.

"NPSI shall be a fully registered non profit organisation in Nigeria, anchored by NSChE, and supported by the collaborative participation of oil & gas, petrochemical and process industry companies..."

THE JOURNEY SO FAR...

1. NSChE took the first step towards successful realization of this objective when a paper entitled 'Imperatives of Process Safety in Nigeria', was presented at the 2016 DPR International HSE Conference on the Oil & Gas Industry to sensitize that industry.

2. A one day mutual conference on Process Safety in Nigeriawas held in October 2017, hosted by NSChE and supported by Department of Petroleum Resources (DPR), with the participation of CCPS of AIChE and the Safety & Loss Prevention Special Interest Group (SIG) of the Institution of Chemical Engineers (IChemE) of UK.

3. Registration of NPSI as a non profit organisation in Nigeria is currently on-going.

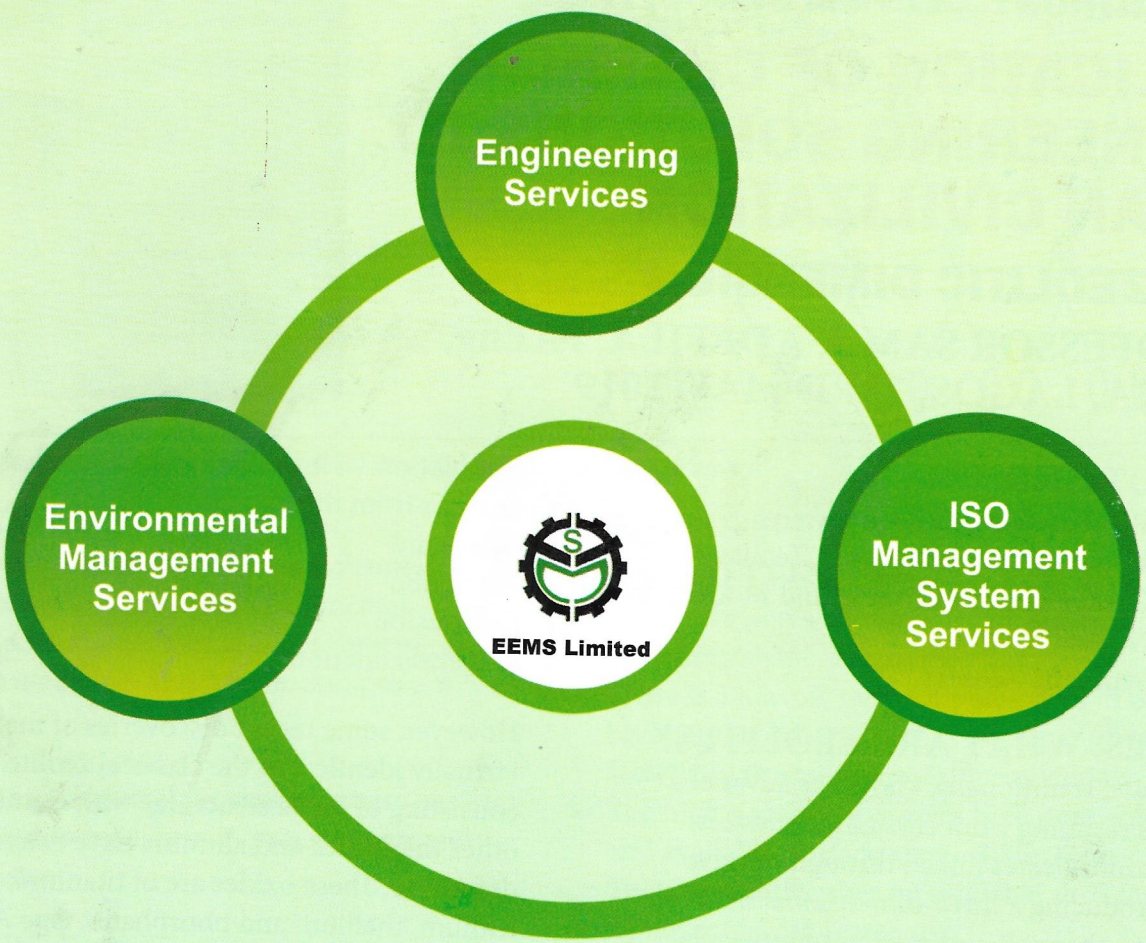
3.0 PLANNED ACTIONS GOING FORWARD

1. We shall soon embark on active membership enlistment drive.

2. Effort would be made to Develop Process Safety Workshop packages for training of members of the academia in Chemical Engineering and related technical disciplines (Petroleum Engineering, Mechanical Engineering, Chemistry, Physics, etc) as well as process industry operators. This will facilitate awareness of the benefit and value of the NPSI programs and compliment the enlistment drive.

4.0 INVITATION TO JOIN NIGERIAN PROCESS SAFETY INITIATIVE

We wish to invite all the oil & gas, petrochemical and process industry companies operating in Nigeria to come and join the NPSI so that together we can make a success of this noble idea which when practiced would ensure thesecurity of assets, safety of lives and properties which otherwise would have been lost.



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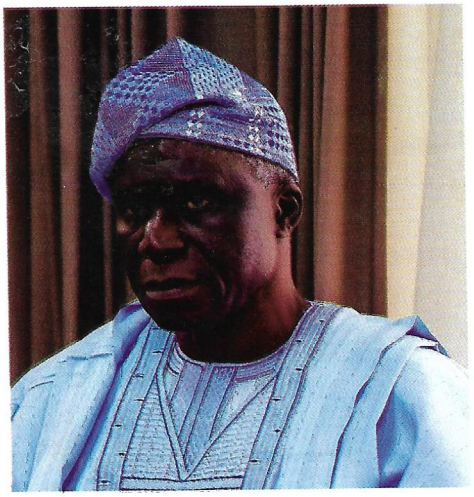
ANNUAL PUBLIC LECTURE AND BIRTHDAY OF ENGR. ANTHONY OLUFEMI SHOBO, FAEng

APPLICATION OF CHEMICAL ENGINEERING SOLUTIONS TO HUMAN CIVILIZATION

• THE ZEOLITIC DIMENSION

BY PROFESSOR SAM S. ADEFILA, FAEng,
AT IKEJA, LAGOS, 23RD MAY, 2019



OUTLINE

- What are Zeolites?
- Why So Much Ado About Zeolites?
- Compelling Background and Motivation
- Natural Zeolites
- Synthetic Zeolites
- Production – How, Challenges and Clues
- Lessons from the Evolution of Zeolites
  -Mankind
  -Pa Shobo
- Conclusion
- Recommendation

ZEOLITES: WHAT ARE ZEOLITES?

* Zeolites are, traditionally, known as advanced materials resulting from crystalline silicates and aluminosilicates linked through oxygen atoms, producing a three-dimensional network containing channels and cavities of molecular dimensions. Such tri-dimensional networks of tailorable micropores can act as reaction channels whose activity and selectivity will be enhanced, by introducing active sites(Corma 2003).

* However, some recent discoveries of materials virtually identical to the classical zeolite, but consisting of oxide structures with elements other than silica and alumina have extended the definition. These oxides are of titanium, gallium, iridium, thallium and phosphates. e.g. AlPOs, SAPOs, GaPOS, etc

ZEOLITE AND BUILDING OF ZEOLITES

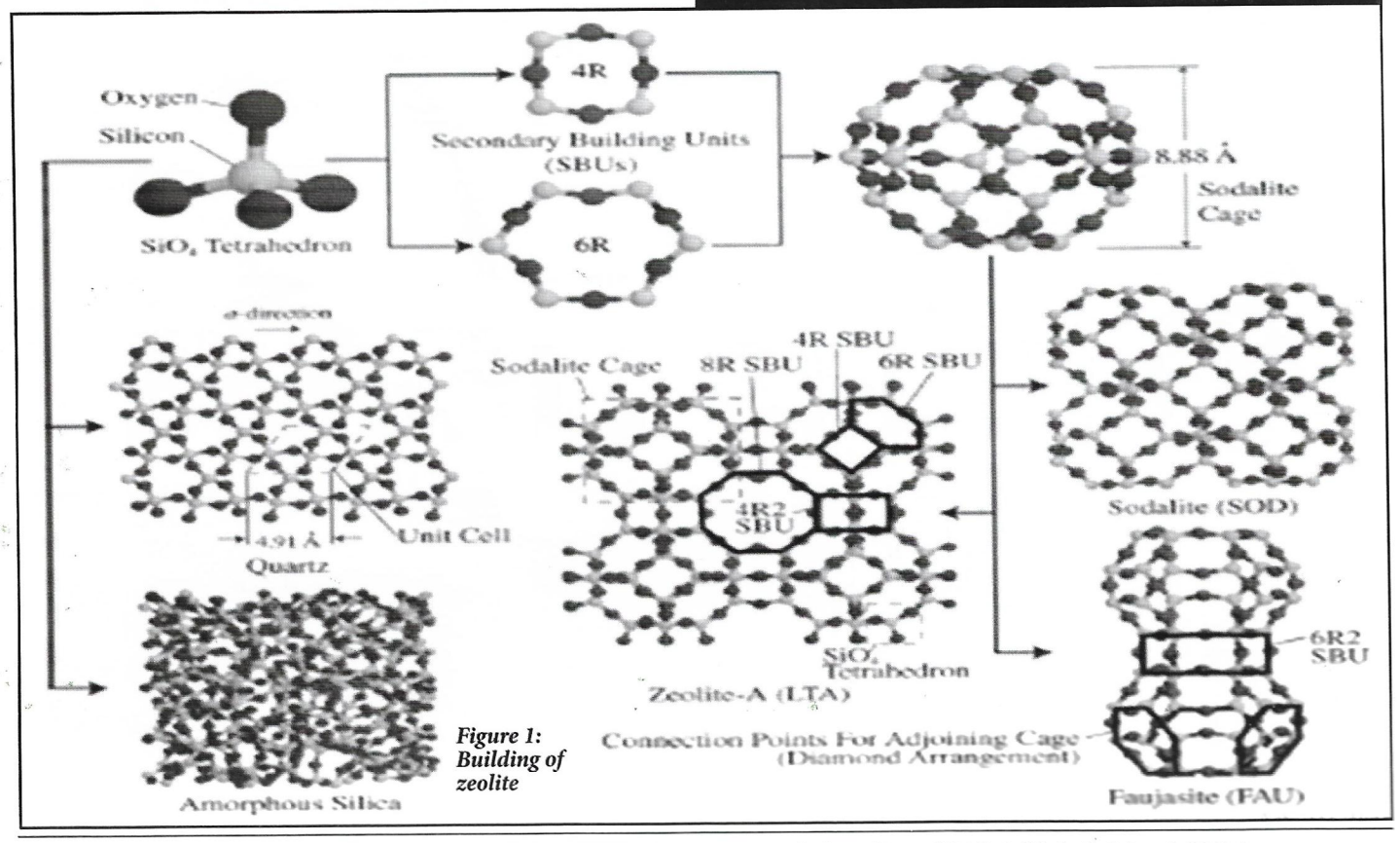


Figure 1: Building of zeolite

BUILDING ZEOLITES

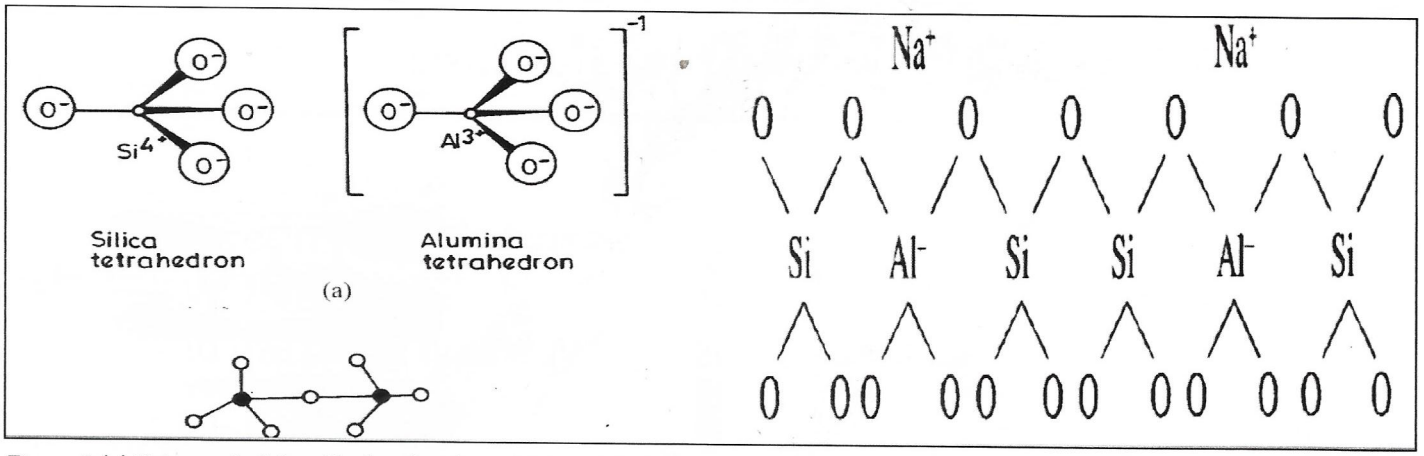


Figure 2 (a) Primary building blocks of zeolites, (b) Simplified surface structure of zeolite

APPLICATIONS

Zeolites have wide applications in petroleum refining processes , including environmental management and many other areas of (heating and refrigeration, medicine, agriculture, etc) present civilization

Use of zeolites in chemical processindustries has dramatically led to reduction in process steps and volume of wastes

WHAT IS SPECIAL ABOUT ZEOLITES?

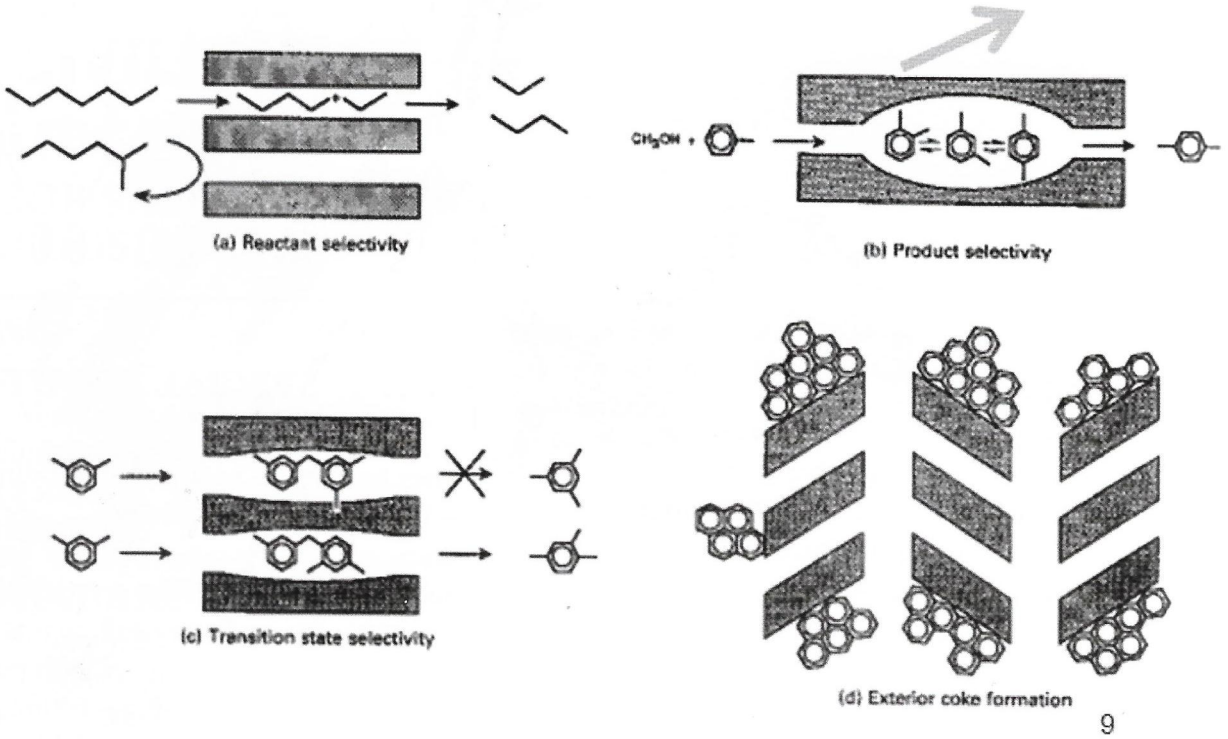
- They have pores with molecular dimensions —leads to shape selectivity
- There is a narrow range of pores sizes in the solid because the materials are crystalline -gives better selectivity than non-crystalline materials
- The high porosity also gives high pore volumes and available surface area ~ 800m2/gm
  They have active sites on available surfaces, for hyper-enhanced reactivity

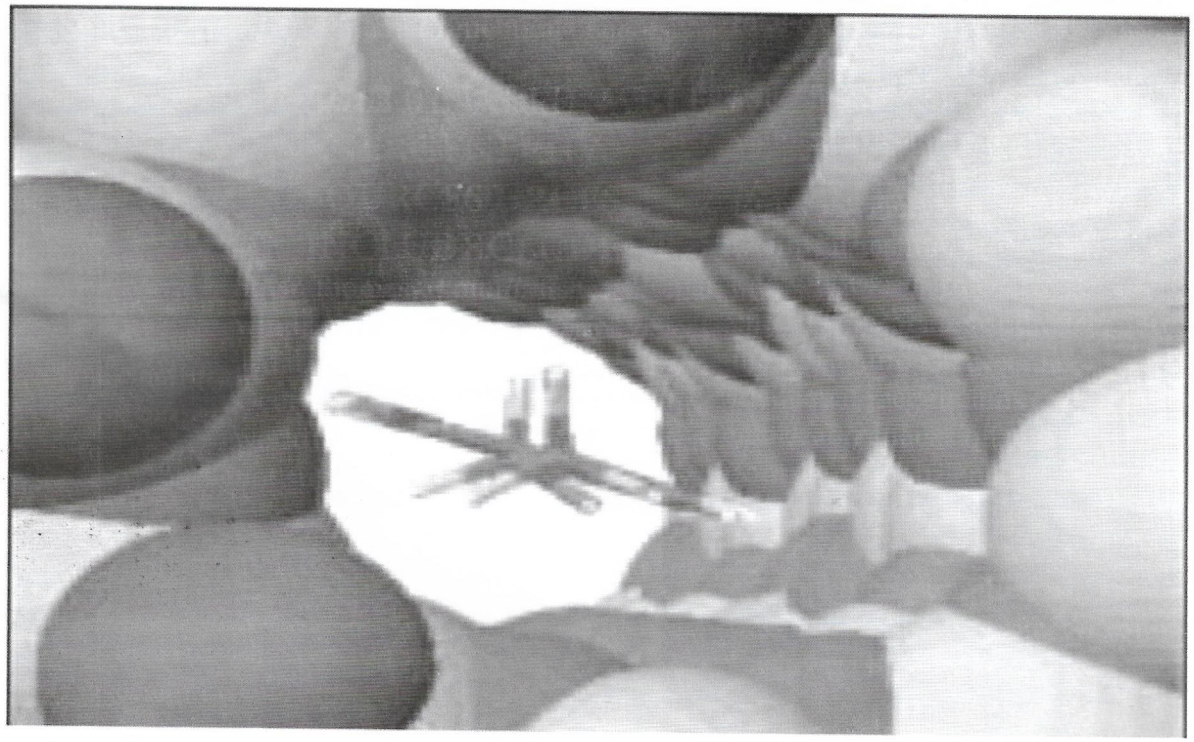
COMPELLING BACKGROUND

Table 1 Property Relations and Potential Applications of Features Presented by Zeolites

Feature	Conferred Property	Potential Applications / Advantages
Porosity	Low density solid	Ease of fluidization arising from low required lift energy per unit mass
Regular pore with mol ecular dimension	Specific pore dimension	Sieving effect, selectivity/controlled reaction and size/product distribution, resulting in limited subsequent separation requirement
High pore volume per unit mass	Thermodynamic suction pump effect	Reduction of diffusion resistance per unit length of pore and higher density of impregnable materials, such as introduced conventional catalysts, in catalysis and absorption of materials such as impurities from environment of zeolite
Entrained cations	Controlled acidity and free passage	Controlled catalytic reactions
High available internal and ionized surface area per unit mass	Enhanced surface area phenomena	High/catalytic reactivity or/and adsorption of material and relatively high and uniform heat transfer, for controlled reaction
Labile entrained charged actions	Ion exchangeability	Selective removal or introduction of cations such as water softening

Shape selectivity





P-Xylene in the channels of ZSM5

Natural zeolites

Zeolites form in nature as a result of the chemical reaction between volcanic glass and saline water. Temperatures favouring the natural reactions range from 27° C to 55°C, and the pH is typically between 9 and 10.

Nature requires 50 to 50,000 years to complete the reaction. Naturally occurring zeolites are rarely phase-pure and are usually contaminated to varying degrees by other minerals [e.g Fe^{++}, $SO4^{-}$, quartz, other zeolites, and amorphous glass]. For this reason, naturally occurring zeol ites are excluded from many important commercial applications where uniformity and purity are essential.

IDEAL METHOD OF ZEOLITE SYNTHESIS

- Zeolites are traditionally synthesized from alumina and silica based chemical reagents with organic templates

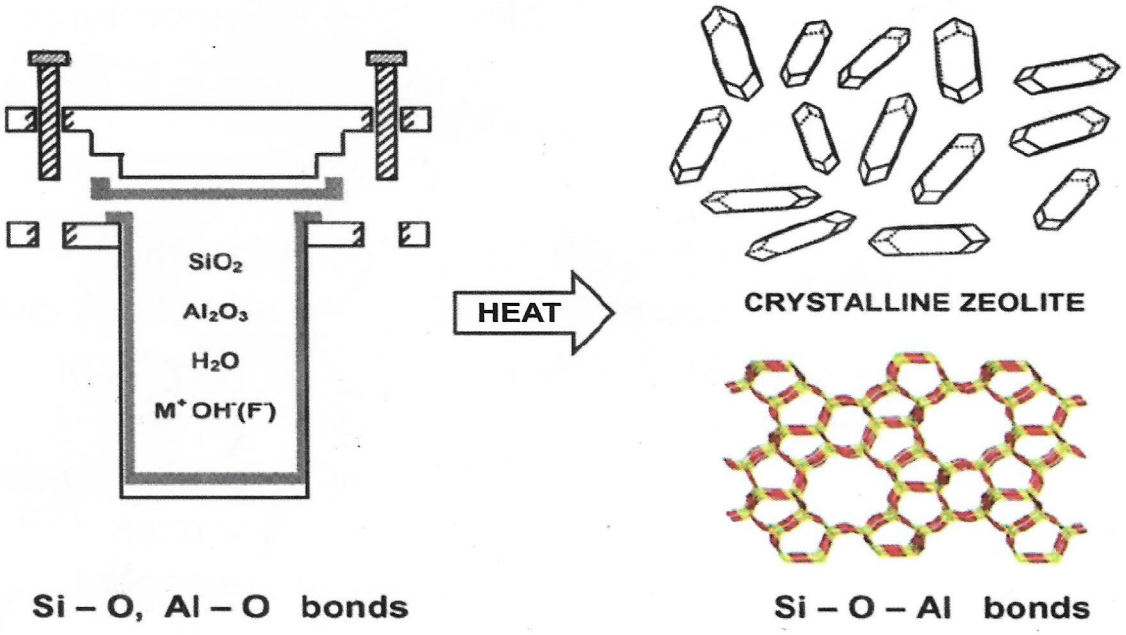
THEORETICAL LABORATORY SYNTHESIS OF ZEOLITE

From simple chemicals

$$NaOH(aq) + NaAl(OH)_4(aq) + Na_2SiO_3 \xrightarrow{25^{\circ}C} \underset{gel\ phase}{Na_a(AlO_2)_b(SiO_2)_c \cdot NaOH \cdot H_2O}$$

$$\xrightarrow{25\text{-}175^{\circ}C} \underset{zeolite\ phase}{Na_j(AlO_2)_j(SiO_2)_y \cdot zH_2O} + solution$$

PRACTICAL LABORATORY SYNTHESIS OF ZEOLITE



COMMERCIAL METHOD OF ZEOLITE SYNTHESIS

- Alumino-silicate rich material such as kaolin, rice husk ash and fly ash are also reported to be used for the synthesis (Chareonpanich et al. 2004, Vempati et al. 2006, Wang et al., 2007)

WHY DO WE SYNTHESIZE ZEOLITE?

- Tailoring for desired properties
- Predictability of properties of zeolite
- Possibility of making desired pore sizes
- Choice of hydrophobic or hydrophilic zeolite formation(varying silica –alumina ratio)
  High silica-hydrophobic and *vice versa*
- Choice of improved catalytic activity, by encouraging either formation of Brönsted or Lewis acid sites

PROCESSES INVOLVED IN TRANSFORMING KAOLIN TO ZEOLITES (20 TO 25 DAYS)

- Mining - probably selective for high grade clay
- Beneficiation - removal of physical and partially chemically bonded impurities
- Calcination - kaolin is not reactive (crystalline), but metakaolin phase is more reactive(amorphous)
- Dealumination - varying the silica-alumina ratio to meet the targeted zeolite
- Gel formation – initiation of nuclei and crystal growth (often involves aging)
- Crystallization - transformation of aged gel, nuclei and crystals into zeolitic material
- Calcination of the desired product to terminate post synthesis effect

FACTORS AFFECTING ZEOLITE SYNTHESIS

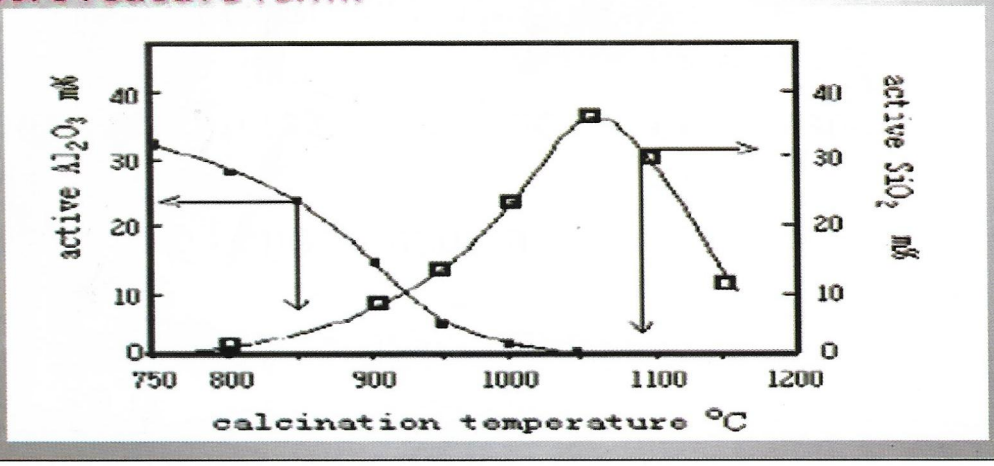
- Mode of dealumination (thermal or non-thermal)
- Batch composition, i.e. Si/Al ratio, H_2O/Na_2O etc
- Temperature and time for crystallization
- pH, i.e. level of alkalinity
- Ageing conditions (time and temp)
- Stirring rate
- Order of mixing
- Purity level of the reagents used and minerals
- Dyeing

CHALLENGES

- Sodium aluminosilicate, not manufactured locally
- Available alumina and silica in local clay, are highly contamina ted with impurities

CLUES

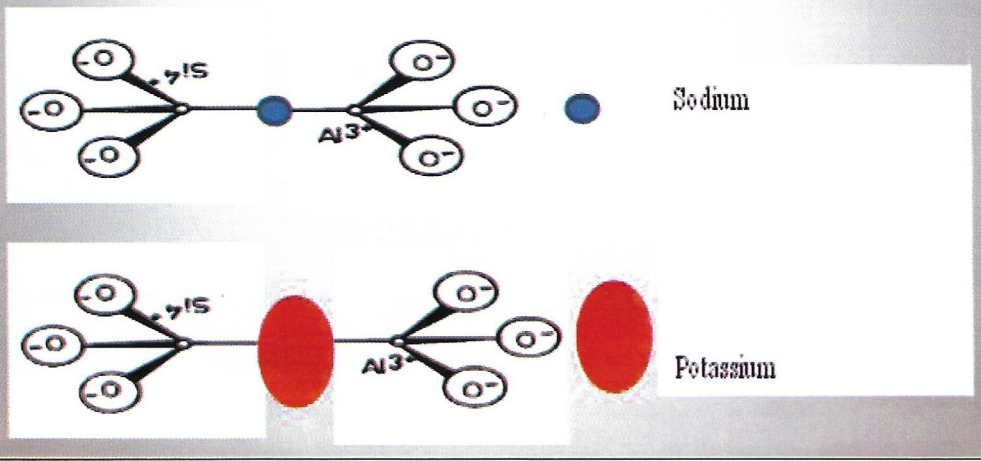
- Thermal conductivity of kaolinite clay and differences in activation temperatures for silica and alumina in the clay, *viz-a-viz* irregularity in voltage supplied by PHCN.
  - Silica can only be activated at 1050°C
  - Alumina can only be activated at 750°C
- Calcination is a major step in conversion of kaolin to a more reactive form.



19

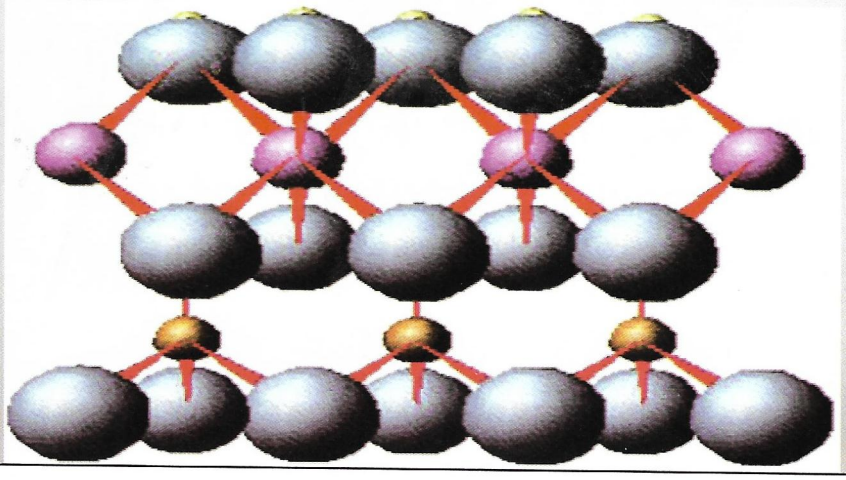
CLUES

- Presence of inherent impurities in the raw, beneficiated and dealuminated material, especially potassium rich mineral



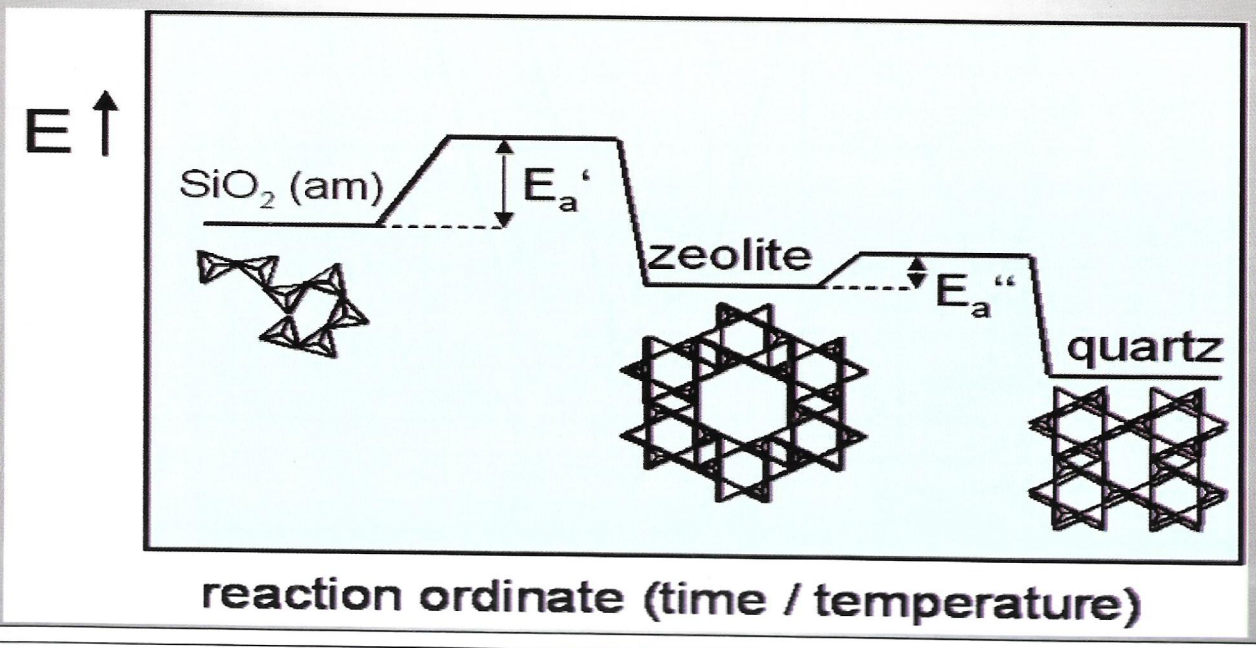
CLUES

- Silica in kaolin is very rigid, which tends to form strong siloxane bridges during and after dealumination. The depolymerization of the resulting silica becomes very difficult



CLUES

- Complex chemistry and thermodynamic favorability of silica recombination



SIGNIFICANCE OF SILICA-ZEOLITE TH ERMOKINETICS

- Activation energy of silica-zeolite higher than that of zeolite-quartz
- Zeolite (metastable) thermodynamically more stable than silica and quartz more than zeolite
- Suggestive of abundance of silica/alumina in nature
- Compare the molecular structure of silica and water
- Suggestive of the potentials of deployment in soil engineering for agriculture inter-alia

EMPIRICAL

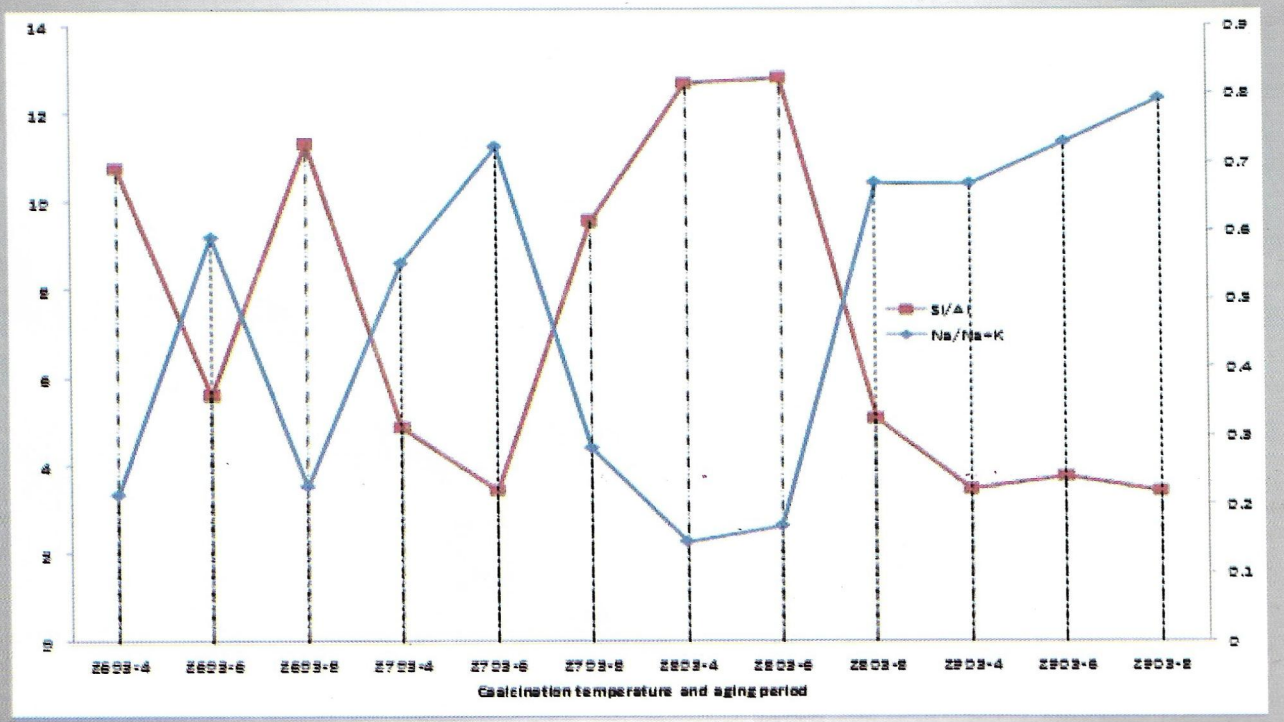


Figure 4: Zeolitization as a function of calcination and aging.

PA SHOBO-THE ZEOLITE OF OUR GENERATION

Zeolite Properties and Application	Pa Shobo's Attributes
High Surface Area	Highly accessible by everybody because of his large heart
Uniform Pore Geometry	Allows things to flow naturally and freely by respecting people's opinions.
Shape Selectivity	Ability to identify potentials in people and use them for good purposes
Building Block for Nanoworld	He is part of the basis or foundation upon which chemical engineering is built in Nigeria
Catalyst for cracking in FCC	His ability to crack and mould us into what we are now. He gladly today remains active and cannot be deactivated like the zeolite being compared with. Pa Shobo till date provides meaningful contributions to the entire chemical engineering family in Nigeria and abroad.

ACTIVATION OF PRINCIPLE OF SOLUBILITY

- Increasing ratio of Na/(Na + K) results in better dissociation of silica, suggesting the significance of the definition of solubility

LESSONS FROM CHEMOTHERMOKINETICS OF ZEOLITES

- Wide and broad

TAKE HOME

- Borrowed from knowledge of chemistry and thermokinetics of zeolite production to synthesize zeolite using kaolin
- This concept can be extended virtually to enhancing values of a wide range of raw materials

EXTENDED TAKE HOME

- Pa Shobo has partaken in undertaking a critical role in the establishment and nurturing of Chemical Engineering in Nigeria
- The responsibility to take it through her present hurdles, for advancement, lies with the current generation
- Find a niche for yourself in the transformation process and apply yourself

CONCLUSION – Research Outcome

- A wide range of zeolites can be synthesized
- Human capital development potentials and solutions to economic and environmental challenges abound

CONGRATULATIONS PA SHOBO

- You have touched and activated every area of chemical Engineering in Nigeria
- You will always be remembered for this

RECOMMENDATION

- Controlled synthesis of industrially important zeolites such as ZSM-5, Y, X, etc from kaolin and other feasible raw materials should be domes ticated in Nigeria
- APPLICATION AND EXTENSION OF SAME INTO AGRICULTURE, MEDICINE, ETC. SHOULD BE INTRODUCED ON NATIONAL POLICY PLATFORM

APPRECIATION

I appreciate the Lagos/Ogun Chapter of the Nigerian Society of Chemical Engineers for giving me the opportunity to give this prestigious lecture My Zeolite PG Students

THANK YOU FOR LISTENING

NSChE DELEGATES' COURTESY VISIT TO GMD, NNPC, MR MELE KYARI

BY SAMUEL O. BOSORO, EXECUTIVE SECRETARY, NSChE

NSChE delegates led by the National President Engr. Onochie Anyaoku paid a courtesy visit to the Group Managing Director of Nigerian National Petroleum Corporation, Mr Mele Kyari on Tuesday 6th August, 2019. The delegates comprised:

Engr. Onochie Anyaoku	**National President**
Engr. Saidu Mohammed	**Deputy National President**
Engr. Abubakar Yar'Adua	**Past President**
Engr. Tony Ogbuigwe	
Engr. Wilson Aladum	
Engr Onyekachi Onugu	
Engr. Dr Steve Momoh	
Engr. Samuel O. Bosoro	**Executive Secretary**

The NSChE delegates were received warmly and with deep enthusiasm by the Group Managing Director (GMD) of the Corporation, Mr Mele Kyari and his team comprising Chief Operating Officers (COOs) and Group General Managers (GGMs).

The NSChE National President (NP), Engr. Onochie Anyaoku made a written presentation to the GMD.

Highlights of his presentation are as follows:

1. The National President congratulated the new GMD on his well deserved elevation to the exalted position and wished him well.

2. He then appreciated the Corporation for the impact which they are making in the economy and especially to the practice of Chemical Engineering in the country.

3. Going further, he sought the support of the Corporation for the Society in areas such as her training and manpower development programs

4. He appealed for registration with the Society and active participation in the Society's activities of all Chemical Engineers working in the NNPC Group.

5. Finally, he invited NNPC Group to be a pioneer Company member of the Nigerian Process Safety Initiative (NPSI) being spearheaded by the Society to deepen Safety knowledge and awareness culture and practices in the process industry.

The GMD of NNPC , Mr Mele Kyari responded to the National President's presentation.

Highlights of his response are as follows:

1. He welcomed to the meeting, the National President , Deputy National President , Past President and all the other delegates most of whom are well known to him.

2. He thanked the NP for affirming his confidence in the team and promised to keep the flag flying while doing things a bit differently so that his team can deliver on their mandate.

3. He then expressed his sadness that as at today all the refineries are down and that this is definitely not acceptable. He observed that the Corporation produced the best Chemical Engineers in the country and yet we have such challenges as this. He did not want to give excuses but assured the delegates that his team would tackle the challenges head-on. The team is determined to ensure that these challenges are tackled and surmounted such that by 2023 the country could become a net exporter of petroleum products.

4. He promised to collaborate with the Society in training young Chemical Engineers , build capacity and also collaborate in any other way to grow the skilled workforce not only for the corporation but for the country itself

5. He promised that the Corporation would support the forthcoming Annual Conference and other programs of the Society that were presented.

"Nevertheless, he assured the NSChE delegates that his team is well determined to tackle these challenges..."

After the GMD's response, the National President (NP) was invited to sign the attendance register.

While the NP was signing the attendance register, Engr Tony Ogbuigwe chipped in the following to fill the gap:

1. He observed that the GMD focused on the refineries in his welcome address

2. Meanwhile, all of us are very passionate on seeing the refineries work.

3. In 2015, The former Minister of State for Petroleum Resources Dr Ibe Kachikwu invited a consulting Group from Europe to advise Government on what needs to be done to revamp the refineries.

4. The leader of the Group was a retired staff of Shell Petroleum Development Company (SPDC) who knew him before while in service.

5. The leader of the Group consulted him extensively on this issue and the thrust of his final report to government were essentially based on the briefs which were given by him.

6. Shell Group of Companies normally utilize their experienced former staff to take the company to higher levels

7. He advised that NNPC should emulate this practice since their former staff also have a stake in the continued existence of the Corporation

8. He posited that the former staff are willing and ready to put the benefit of the experience which was built while in service at their disposal to help in raising the Corporation to higher levels.

The GMD, Mr Mele Kyari responded to Engr Tony Ogbuigwe's submission.

Highlights of his response are as follows:

The Corporation has a lot of serious challenges to tackle before the refineries can function properly.

1. **Crude Supply line**
   There are no adequate crude supply lines to any of the refineries. This must be tackled as the refineries would only be able to process the crude supplied.

2. **Deterioration of the Plant**
   Since 1993 to date, we have not been able to get the maintenance of the refineries right. Consequently, deterioration has gone down from a level that was known to a level that we don't know. However, effort is being made to determine their current state such that by end of October, 2019, the Corporation would have a better knowledge on the actual state of the refineries.

3. **Finance**
   The Corporation does not have money to revamp the refineries.
   Also, there is no money in the Federation.
   External Finance cannot be secured because the right balance sheet is required to do so and this is not available at the moment.

Nevertheless, he assured the NSChE delegates that his team is well determined to tackle these challenges and ensure that they are surmounted.

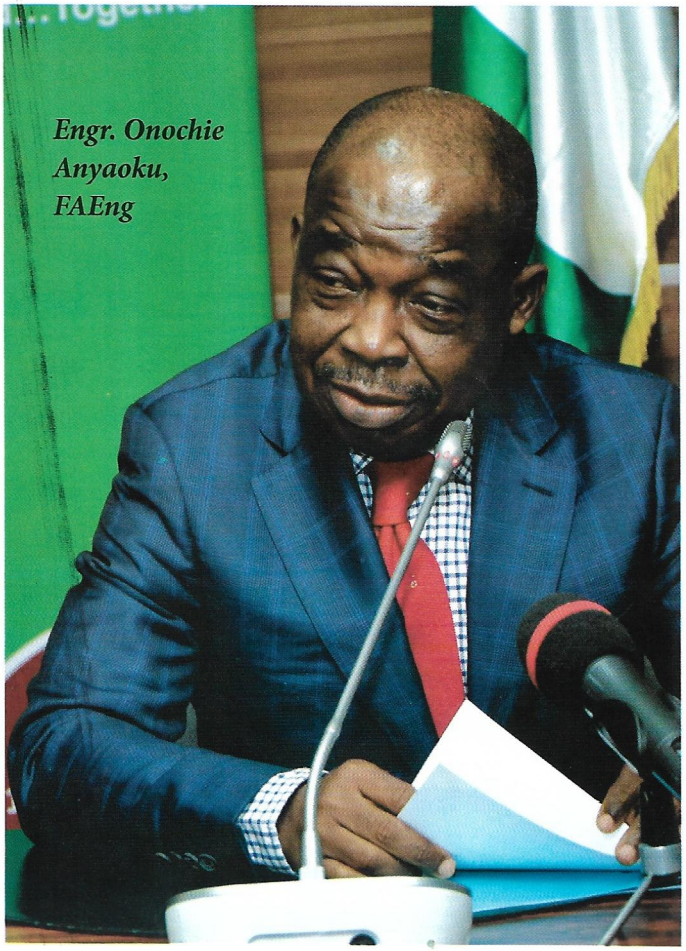
Finally, the GMD on behalf of the Corporation gave the National President a token of appreciation and their Newsletter.

At the end of the meeting , group photographs we taken.

PICTURES OF NSChE VISIT TO THE GMD, NNPC

At the Centre, NNPC-GMD, Mr. Mele Kyari, to his left, NSChE-DNP, Engr. Saidu Mohammed, to his right, NSChE President, Engr. Onochie Anyaoku, 3rd from his right are other NSChE delegates: Engr. Abubakar Yar'adua, Engr. Tony Ogbuigwe, Engr. Wilson Aladum, Engr. Onyekachi Onugu, Engr Samuel Bosoro and Dr. Steve Momoh

Right: The NNPC Group Managing Director, Mr Mele Kyari in a warm handshake with NSChE National President, Engr Onochie Anyaoku



Engr. Onochie Anyaoku, FAEng

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SUSTAINABLE ENERGY AND OUR ENVIRONMENT

BY ENGR. DR. GODWIN UDOH, *FNSChE*

1.0 INTRODUCTION

Sustainable Energy is energy produced and utilized in ways that support human development in all its economic, social, and environmental dimensions. Providing an adequate, affordable energy is essential for eradicating poverty, improving human welfare, and raising living standards world-wide. No single human society can survive without a continuous use, and hence supply, of energy. Renewable energy contributes to the sustainability of specific communities by providing them with a wide variety of socioeconomic and environmental benefits.

2.0 SUSTAINABLE ENERGY SOURCES INCLUDE:

Solar, Biomass, Land/Offshore wind turbines, Hydroelectricity, Tidal, Wave, Nuclear and Geothermal. The current worldwide energy systems are not sufficiently reliable or affordable to support widespread economic growth.

Fig.1: Hydroelectric dam

3.0 NIGERIA ENERGY SUPPORT SYSTEMS:

Available data indicate that with a share of 2% in the total final energy consumption, electricity remains a marginal source of energy in Nigeria. Furthermore, electricity only represents 9% of the household's total energy consumption. Electricity consumption from residential and commercial sectors represented 80% of the total electricity demand. The rest are covered by the industrial, street lighting and special tariff sectors.

Heavy reliance on gas, limited technical/technological know-how, lack of energy efficiency practices and infrastructure maintenance, inadequate regulations and attacks on energy infrastructure contribute to the challenges the sector is facing. Currently Nigeria's average electricity consumption per inhabitant is only 150 kWh per capita, one of the lowest in the world.

There are plans underway by the Federal Government of Nigeria, in its Power Sector Reform Roadmap to increase installed hydro power generation to 5,690 MW, thermal to over 20,000 MW and renewable energy to1000 MW capacity. The targets also aim at diversifying Nigeria's energy mix to reduce its natural gas dependence. The Federal Ministry of Power had earlier, launched the initiative: Operation Light-up Rural Nigeria, which is aimed at utilizing renewable energy for electrifying rural communities in all 36 States in the country including the Federal Capital Territory (FCT).

Although States' electrification interventions focus mainly on grid extension, some have also installed off-grid Photovoltaic (PV) water pumping systems and off-grid PV street lighting. A few of them have implemented an elaborate off-grid PV village electrification projects with the private sector participation.

4.0 GLOBAL ENERGY STRATEGIES:

Harnessing power from the wind is one of the cleanest and most sustainable ways to generate electricity as it produces no toxic pollution or global warming emissions. Wind is also abundant, inexhaustible, and affordable,

which makes it a viable and large-scale alternative to fossil fuels. The productivity of one-third of the world's population is compromised by lack of access to commercial energy. In developing countries, primary energy demand is expected to grow at about 2.5 percent a year as industrialization gains momentum. This is necessary if developing countries aspire to achieve economic prosperity.

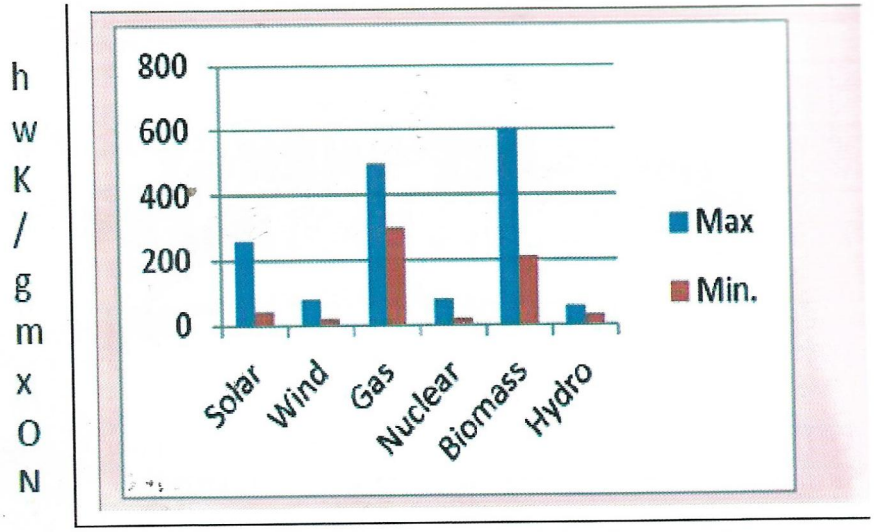


Fig.3: Energy Ratios for various Energy Sources

It is important to note, that energy production, conversion, and use always generate undesirable by-products and emissions-at a minimum in the form of dissipated

Fig.2: Typical Geothermal plant

heat. The combustion of fossil fuels is responsible for most urban air pollution, regional acidification, and risks of human induced climate change. The use of nuclear power hascreated a number of concerns about the safety of nuclear installations, the storage and disposal of high-level radioactive waste, and the proliferation of nuclear weapons.

Notwithstanding the vast potential of wind energy, there are a variety of environmental impacts associated with wind power generation that should be recognized and mitigated.

Burning natural gas for electricity releases between 0.6 and 2 pounds of carbon dioxide equivalent per kilowatt-hour (CO_2E/kWh); coal emits between 1.4 and 3.6 pounds of CO_2E/kWh. Wind, on the other hand, is responsible for only 0.02 to 0.04 pounds of CO_2E/kWh on a life-cycle basis; solar 0.07 to 0.2; geothermal 0.1 to 0.2; hydroelectric between 0.1 and 0.5. Different sources of energy produce different amounts of heat-trapping gases. As shown in this chart, renewable energies tend to have much lower emissions than other sources, such as natural gas or coal.

Biomass facilities raise certain concerns about air emissions, just as that of fossil fuels. However, the feedstock of biomass facilities can be sustainably produced, while fossil fuels are non-renewable. In some developing countries the use of biomass contributes to desertification and biodiversity losses.

Air pollution can lead to the formation of acid rain which can in turn reduce the quality of natural water systems by increasing the acidity.

Biomass resources for producing electricity are diverse and include energy crops (like switchgrass), agricultural waste, manure, forest products, and urban waste. Both the type of feedstock and the manner in which it is developed and harvested have significant impact on land use and global warming.

Exposure to indoor air pollution is a well-documented health risk associated with the use of biomass fuels in traditional stoves that are little more than shielded fires in poorly ventilated kitchens. Thus in addition to its relatively high cost, the use of biomass fuel may promote higher medical care expenditures among rural dwellers.

The environmental impacts associated with solar power include land/ water use, habitat loss, and the use of hazardous materials in manufacturing. However, the types of impacts vary greatly depending on the scale of the system and the technology used—PV solar cells or Concentrating Solar thermal Plants (CSP).

The process of manufacturing PV panels also entails the use, or by-product production, of a number of hazardous materials that must be monitored, handled, and disposed of properly to minimize risks to workers, the public, and the environment. In addition to Silicon tetrachloride (SiCl4), these substances include silane, a highly flammable intermediate of polysilicon production, hydrofluoric acid (HF), toxic gases and acids used in cleaning silicon wafers.

The presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere causes the ozone layer to deplete, leading to the emission of harmful radiations back to the earth.

Over the years, new technologies, including engine design modifications, have reduced Nitrogen Oxides (NOx) and Particulate Matter (PM) emissions from diesel vehicles by about 80-90 percent. To date, diesel oxidation catalysts are the only exhaust control devices applied to diesel passenger cars. This is achieved through selective catalytic reduction, NOx adsorbers and plasma assisted catalysis. Combustion cylinder alterations and good mixing of the air and fuel injected into the combustion cylinder reduces both NOx and PM emissions.

Interestingly, there are very viable technologies that can significantly reduce, either directly or indirectly, mobile source emissions of CO_2, N_2O (as well as other NOx emissions), CH4, and black carbon.

Another proven method is the use of Biodiesel (BD). Biodiesel is derived from liquid feedstocks, such as animal fats and vegetable oils. Also soybeans are the largest source of biodiesel in some countries; but rapeseed (canola), tallow can also serve as feedstocks. Diesel Particulate Filters (DPFs) remove particulate matter in diesel exhaust by filtering exhaust from new and existing diesel engines. DPFs can achieve up to, and in some cases, greater than, 90% reduction in diesel particulate matter (PM).

In the case of gasoline vehicles, currently used worldwide, direct fuel injection technology enables gasoline engines to achieve greater fuel efficiency. In a gasoline direct injection engine, gasoline is directly injected into the cylinder the same way as in a diesel engine. It has been established that gasoline direct injection permits more fine-tuned control of the amount of fuel injected as well as control of injection timing independently from valve timing.

Gasoline direct injection engines can reduce CO_2 emissions in a number of ways, including better "breathing" efficiency, higher engine compression ratio and the potential for lean operation and reduction of pumping losses. This process permits CO_2 emissions reductions ranging from 5% to 20%.

Exhaust emission controls for gasoline and diesel engines are also generally compatible with low carbon, alternative fuels (e.g., gasoline blends with renewable ethanol or biodiesel blends). This can provide additional reductions in mobile source greenhouse gas emissions.

Under stoichiometric conditions, a three-way catalyst can significantly reduce emissions of NOx, HC and CO. The use of three-way catalyst allows for simultaneous conversion of HC, CO, and NOx produced during the combustion of fuel in a spark-ignited engine.

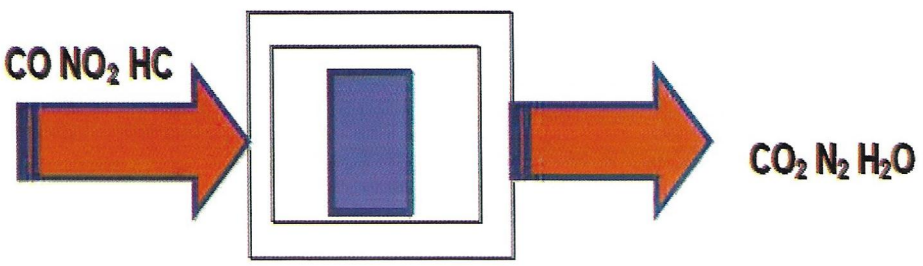


Fig.4: Schematic diagram of a three-way converter

A three-way catalyst can reduce these air pollutants by up to 90% and above

5.0 ADVERSE EFFECTS OF BLACK CARBON:

Black carbon is a major component of particulate matter emissions from mobile sources, and is believed to have a significant net atmospheric warming effect by enhancing the adsorption of sunlight. It is a mix of elemental and organic carbon emitted by fossil fuel combustion, bio-mass burning, and bio-fuel cooking as soot. It is the main absorber of visible solar radiation in the atmosphere. Anthropogenic sources of black carbon are transported over long distances and are most concentrated in the tropics where solar irradiance is highest.

Due to the combination of high absorption, a regional distribution roughly aligned with solar irradiance, and the capacity to form widespread atmospheric brown clouds in a mixture with other aerosols, emissions of black carbon are thought to be the second strongest contribution to climate change after CO_2 emissions.

It is believed that, soot and other forms of black carbon could have as much as 60% of the current global warming effect of carbon dioxide. Black carbon plays a major role in the dimming of the surface and a correspondingly large solar heating of the atmosphere.

Diesel particulate matter emissions account for 30% of black carbon globally. It is estimated that 70% of the black carbon emissions from mobile sources are from diesel-fueled vehicles, with the assumption that 40% of gasoline and 60% diesel PM are black carbon respectively. In this respect, up to 25% of the carbon footprint of a heavy-duty diesel truck is associated with black carbon exhaust emissions.

Human activity is the ultimate driver of environmental degradation, but it doesn't have to be. Cleaner, more sustainable technologies are being developed all the time. It is, critical for any energy reform to be anchored on a pollution-free technology.

Nigeria and other developing countries in particular, should, therefore, identify and develop economically-viable and environmentally-sound energy sources to promote developmental objectives.

In this regard, the adoption of renewable energy technologies will help to address the environmental challenges that emerge due to greenhouse gas emissions as a result of power generation from oil, natural gas, and coal.

Investment in energy by the private sector needs to be encouraged as the projections for the industry in the next decade signal a positive trend, coupled with the sustained macroeconomic improvement.

Most renewable energy sources produce little to no global warming emissions. Even when including "life cycle" emissions of clean energy (the emissions from each stage of a technology's life-manufacturing, installation, operation, decommissioning), the global warming emissions associated with renewable energy are minimal.

Implementing the concept of public health tracking system which involves collection, integration, analysis, and interpretation of data on environmental hazards and their consequent exposure will enhance a strict monitoring of the impacts of these hazards.

In conclusion, it's obvious that:

(a) without energy security, sustainable development would also remain a dream in perpetuity. In other words, energy security and sustainable development are positively related.

(b) the availability of affordable and adequate energy services in rural areas could lead to significant improvements in living conditions and to the fulfillment of basic human needs over a relatively short time frame.

(c) the negative local, regional, and global environmental impacts of energy production and use, threaten the health and well-being of current and future generations, and mitigating such impacts should remain the responsibility of both energy producers and consumers.

SAFE USE OF COOKING GAS

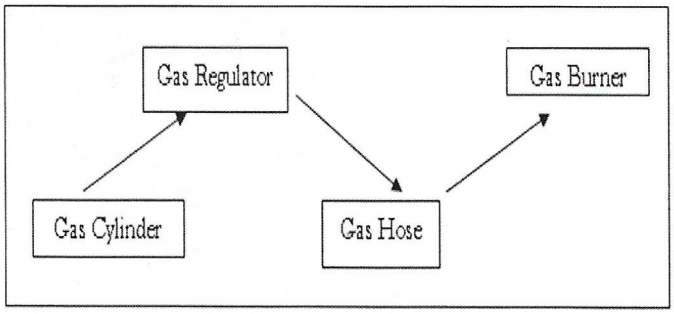
BY MR. AYO AIYEDE, *B.Eng*

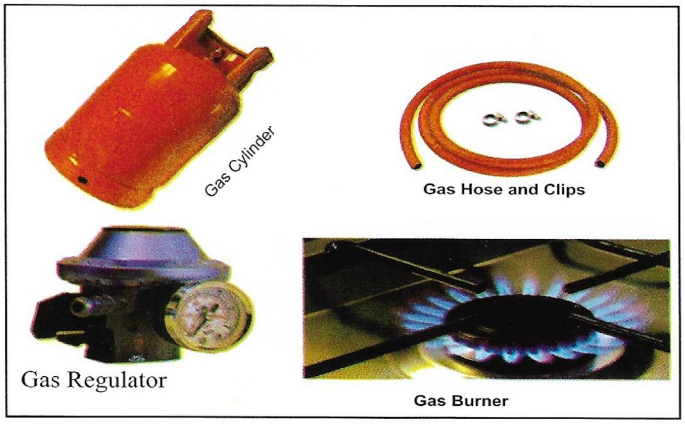
INTRODUCTION

Home safety refers to the awareness and education of risks and potential dangers in and around a home which may cause bodily harm, injury to those residing in and around the physical structure of a home. Most accidents that happen in the home take place in the kitchen. Therefore adequate measures must be taken for kitchen safety.

A common cause of fire outbreak/explosion in our contemporary time is cooking gas. Cooking gas a.k.a Liquefied Petroleum Gas (LPG) is a flammable and highly volatile gas that has the potential to create a hazard. Statistics shows that several gas explosions that occur in homes are caused by mishandling of gas appliances and ignorance of gas users.

CHANNEL OF COOKING GAS FLOW





EFFECTS OF OTHER DOMESTIC FUELS (WOOD, CHARCOAL AND KEROSENE)

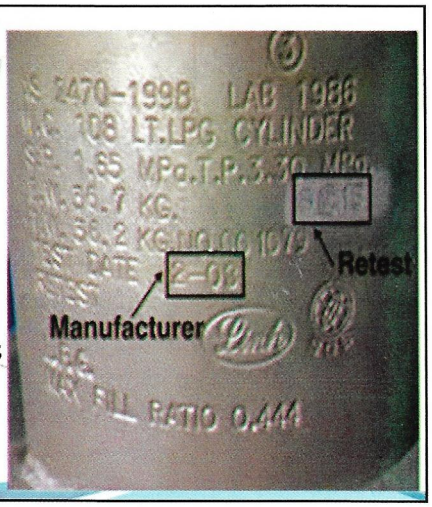
- Emission of poisonous gases such as Carbon monoxide which reduces the oxygen carrying capacity of the blood.
- High levels of household air pollution with a range of health-damaging pollutants which can cause heart disease, lung cancer (carcinogens), stroke etc
- Black soot(Damage pans and create stains)
- The burden of fire wood and charcoal collection
- High Cost and financial implication

ADVANTAGES OF COOKING GAS OVER OTHER SOURCES OF DOMESTIC FUEL

- Odour free cooking
- Absolute control over flames and heat
- Cheaper
- More reliable, no interruptions brought about by power failures
- Environmentally friendly; no smoke emission
- It does not damage pans and create stains.

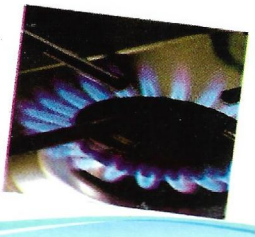
SAFETY MEASURES IN THE USE OF LPG

1. Ensure to always check the test and manufacturer's date on your gas cylinder



2. Ensure your gas cylinder is kept outside the kitchen and not close to a generator set. It is unsafe to keep your gas cylinder in the kitchen

3. Don't turn ON your gas cooker when you can smell leakage.



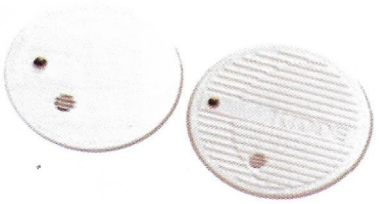
- **4. Ensure there is fire extinguisher (dry chemical powder) in the kitchen to handle minor fire outbreak: Over 80% of homes in Nigeria don't have fire extinquishers**

5. Ensure there is adequate ventilation in the kitchen for correct burning of your gas to prevent the emission of poisonous gas

carbon monoxide alarm

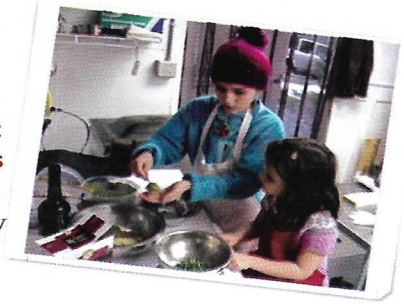
Symptoms of carbon monoxide Poisoning

6.Ensure you install Smoke Detector in your home office, school, industry etc



Smoke Detectors

7. Never leave your cooking unattended to even for a few moments. It is one of the most common causes of domestic fire



8. Never allow a child to cook without an adult supervision

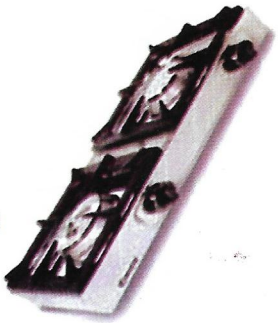
9. Turn off the gas cylinder before you leave your home and before you go to bed each night:

10. Don't repair gas appliances by yourself. Get a professional to repair it

Pressure Safety Valve

11. Don't temper with the safety valve for any reason. Your cylinder valve MUST have vent to evacuate excess gas build up

12.Use gas appliances that are approved and are of good quality. Ensure that all the parts have proper certification.



13. Clean the grease on the burner so as to keep the burner holes unblocked. In case of boiling over, clean the burner as soon as possible.

14. Don't allow boiling over to quench part of your gas burner to prevent emission of Carbon monoxide poisoning.

15. Install kitchen exhaust fan to remove combustion products, fumes, smoke, odors, heat and steam from the air by evacuation of the air and filtration.

Exhaust Fan

CHEMICAL ENGINEERING EDUCATION AND INFORMATION TECHNOLOGY

BY PROF. A. S. AHMED

Prof. A. S. Ahmed
(Department of Chemical Engineering Ahmadu Bello University, Zaria)

1.0 INTRODUCTION

Chemical Engineering is concerned with the design and operation of processes in which materials undergo change, for making a wide range of products on which everyone's standard of living depends. These include food, fuels, medicines, plastics and the basic materials for high technology industries. Chemical Engineering is quite distinct from other engineering disciplines because it is based on the physical and chemical principles common to all processes that handle gases, liquids or solids in bulk.

Capabilities are developed from the outset through engineering experiments, design and research projects and computer simulations. Once a chemical, biological or physical process has been successfully accomplished on the laboratory scale, professional engineering skills are required to translate it into industrial practice which is safe, economically viable and environmentally acceptable.

2.0 IMPACT OF INFORMATION TECHNOLOGY ON CHEMICAL ENGINEERING EDUCATION

Information Technology has revolutionized education, and computers have become the most important educational tools today. The year 1990 marked the creation of an Internet Protocol called the "world wide web" by Tim Berners-Lee. In the 1980s the internets were available but only limited to individual big government agencies and multi-national corporations.

Latest global knowledge and information are currently available to every member of the globe, anywhere and anytime at the click of a computer mouse through the Internet facility. It has made information to flow faster, more generously and less expensive throughout the planet. In Chemical Engineering education computer training has become a necessary background to aid the graduate to design processes and equipment, understand the reactions taking place, install control systems, start up processes and run them safely, efficiently and with minimal environmental impact. Computing courses in Chemical Engineering programmes have become more prominent in the course modules with more contact hours. The modern chemical engineering student has direct and easy access to computers and internet facilities.

2.1 THE PLACE OF COMPUTER IN CHEMICAL ENGINEERING EDUCATION

Kassim and Cadbury (1996) have identified four areas of computer applications that now feature prominently in a Chemical Engineering degree programme.
These are:

1. Process modelling and simulation
2. Programming
3. Computer based control of processes
4. Computer assisted learning

As a pre-requisite, basic IT skills using the desktop computer and peripherals must be learned. Word processing, spread sheet and data base programmes are covered in this preliminary stage.

2.1.1 Process Modelling and Simulation

Computer has brought to modelling an engine, providing faster computation or more of it, and a high-capacity and flexible memory. Some mathematical

models previously impractical because of the extensive calculation required have now become very useful.

Industry-standard softwares are now available for teaching in the area of process and equipment design, modelling, simulation and evaluation. With the introduction of desktop PC based computing and user-friendly interfaces students can even start at the early stages of the undergraduate programme. Two examples are the process flow-sheeting and modelling package called HYSIM and the more mathematically complex computational fluid dynamics (CFD) package.

2.1.2 Programming

Programming is meant for the writing of computer software in high level language e.g. Turbo- Pascal or C – language. There have been arguments on its relevance in Chemical Engineering curriculum.

Edwards (1991) has advocated its exclusion because it is slow, tedious and easy to make mistake. And that it consumes useful time yet it is not easy to assess. But the generality of the people believed that the function of the computer is the object of the learning and so the computer has more right to be part of the learning process.

2.1.3 Computer based Control of Processes

Processes that involve complex interactive dynamics which are difficult to operate and control are assisted by the use of computer. Computer – aided operability and controllability studies are undertaken to increase the knowledge of the poorly known process phenomena which may include the chemical reaction kinetics, the transport problems, material transformation, etc. The energy efficiency, resiliency and flexibility of a complete process can also be studied with the aid of the computer using steady-state synthesis methods e.g. the pinch method. Computer – aided data logging and control of experimental research rigs are ever on the increase.

2.1.4 Computer Assisted Learning

The ability to undertake study on one's own is a crucial feature of adapting to University education by young people (Wankowski 1991). Strategies for promoting self-directed study are important in ensuring student success. For example mathematics is a logical and essential tool in chemical engineering.

A typical mathematics route for solving engineering problem is illustrated in Figure 1 below. Unfortunately, often a times students are weak in their mathematics backwards. Computer – interactive mathematics tuition serves the dual purpose of motivating and increasing students confidence in mathematics on the one hand, and also increasing the potential contact time between tutor and student.

2.2 FUTURE AREAS OF CAUTION IN THE USE OF COMPUTER

Beynon (1993) submitted that excessive reliance on the computer in teaching can over – emphasize the rational, deterministic aspects of the subjects, and inhibit some thinking and learning processes. Paper (1993) sets forth a vast range of possibilities for computer – based education. Learning is a process involving the student, the material to be learnt, and the student's teacher. The interactions that the student makes with material and teachers are many and varied, and education can only succeed by careful attention to these many interactions and their outcomes. When a computer is used as a tool in education, in what way does the student interact with it? The answers can guide us towards using the computer where it is genuinely useful, and discarding it where it is not.

In process modelling, the danger however, is that a student may become quite proficient at the use of a computer modelling package but understand very little of what goes on inside. But again far more time is demanded than is available in the course duration. A balance can be striked by being selective. For instance chemical engineering syllabus can be changed to include increased coverage of Chemical thermodynamics. And assessment at computer practicals should be carried out in a manner that ensures that students are actually doing the work themselves. This can be by attendance registers, written and viva examinations. The use of the computer in self tuition must be considered carefully; it should support and reinforce the student's independence. But it should not blind the student to the importance, when necessary, of reading, listening observing, discussing with peers and seeking help from teachers.

3.0 COMPUTER USAGE IN CHEMICAL ENGINEERING PROGRAMMES IN NIGERIA

The National University Commission (NUC) minimum requirements stipulated that apart from the mathematical courses there should be a minimum of 3 credit units of computer Engineering/Science course in the Chemical Engineering programme of Nigerian Universities (NUC, 1988). The National Board for Technical Education (NBTE) also required a minimum of 3 credit units of Computer Programming in the HND Chemical Engineering programme in the Polytechnics (NBTE, 1990).

As at today there are fifteen federal and state universities and six polytechnics offering Chemical Engineering in Nigeria. In all these institutions the computer hardwares and facilities available in the Chemical Engineering Departments are very limited. The statistics collated by the Nigerian Society of Chemical Engineers in July 2001 showed that only the programmes in the first generation federal universities (Obafemi Awolowo University (OAU), University of Lagos (Unilag) and Ahmadu Bello University (ABU)) have some reasonable level of computerization. None of the departments has its own internet facility, although, the department in ABU has local area network and plans to connect to internet before the end of the year.

Something must be done fast to become part of the information technology revolution. Technology education without a substantial content of information technology will be meaningless in the twenty-first century. Full access to the internet is just as important these days as having access to a good library.

Therefore, government, parents, organizations, alumni and privileged individuals must come to the aid of the institutions to take advantage of the knowledge and information base available at cost effective price and in an interactive form. A modern programme should give graduate a competitive edge both in terms of attitude and training for his years ahead.

4.0 CONCLUSION

Information Technology has revolutionised education and computers have become the most important educational tools today.

In Chemical engineering education computer training has become a necessary background to aid the graduate to design processes and equipment, understand the reactions taking place, install control systems, start up processes and run them safely, efficiently and with minimal environmental impact. The use of internet facilities and software packages in process modelling, programming, control of processes and self tuition has continued to increase in chemical engineering education while in Nigeria these global advances have not made much impact on the local programmes.

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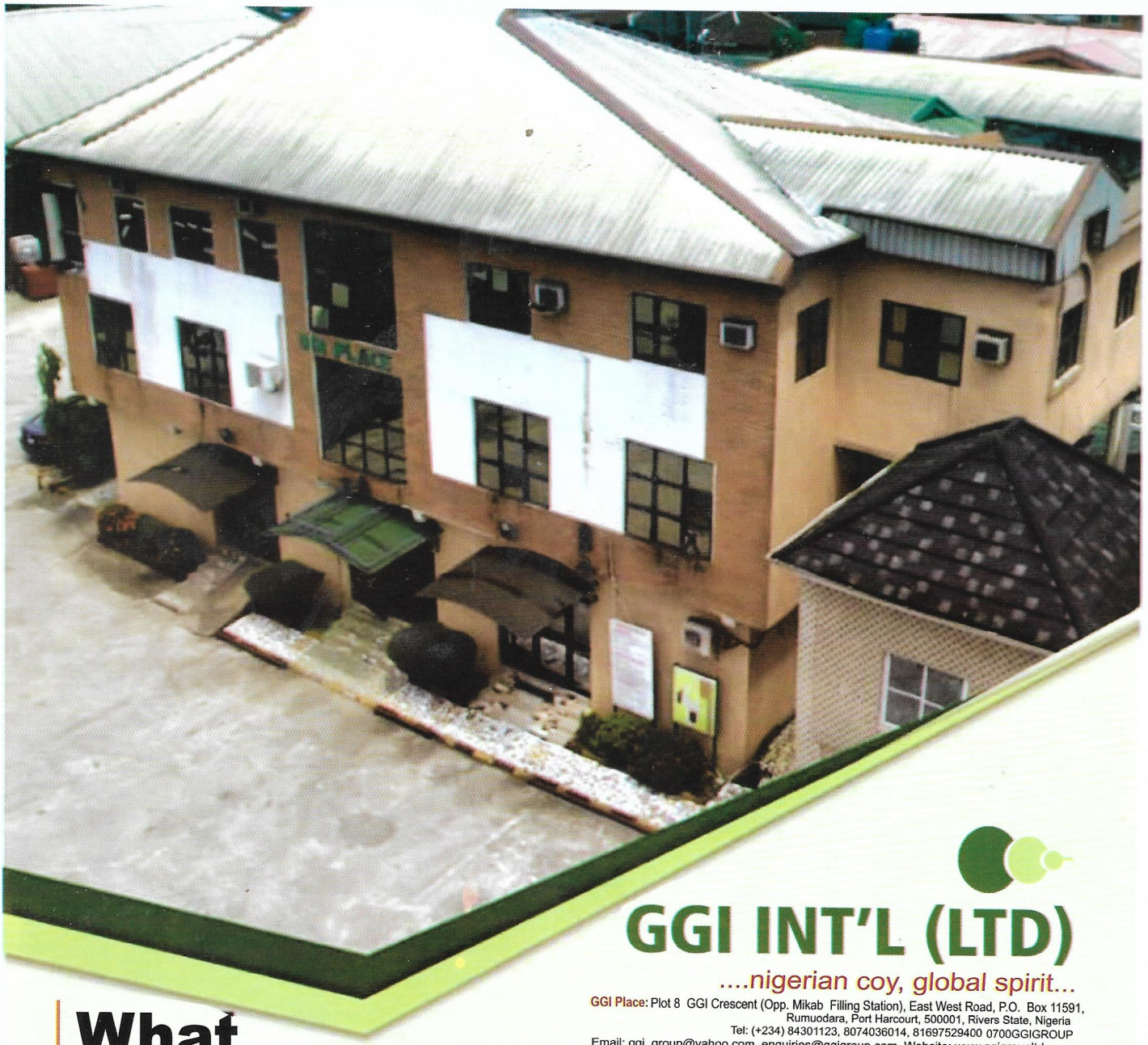
Right: NSChE National President, Engr. Onochie Anyaoku receiving a gift from COREN President, Engr. Ali Rabiu during his visit to COREN

Front row: 2nd from left, FCT/Nasarawa Chapter Chairman, Engr Onyekachi Onugu, NSChE National President, Engr. Onochie Anyaoku , COREN Registrar, Prof. Joseph Odigure, NSChE Immediate Past President, Prof. Sam S. Adefila and Engr. Mamoud Abubakar



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