RMRDC TECHNO-EXPO '09

A Technology and Innovation Fair

THEME: HARNESSING NATURAL RESOURCES FOR NATIONAL DEVELOPMENT

TECHNO-EXPO '09

A Technology and Innovation Fair

SOURVENIR

INTERNATIONAL CONFERENCE / SEMINAR ON HARNESSING NATURAL RESOURCES FOR NATIONAL DEVELOPMENT.

EXHIBITION OF RAW MATERIALS PROCESS EQUIPMENT AND TECHNOLOGIES

EXHIBITION OF PRODUCTS OF RAW MATERIALS R & D RESULTS

RAW MATERIALS LOCAL CONTENT AWARDS

FEBRUARY 10 - 13, 2009 ABUJA, NIGERIA

11.	Research and Development of Rafia Palm Leaves for various Applications for National Development	I.C. Ndukwe
12.	Cost Reduction in Housing Delivery in the use of Natural Building Materials	C.C. Munonye

LATE AFTERNOON — Plenary Session IV

SUB-THEME: **EVOLVING TRENDS IN ADVANCED MATERIALS DEVELOPMENT AND UTILIZATION**

TIME: **4:00-6:00 P.M.**

VENUE A: **RMRDC, AUDITORIUM**

Chairman: **Prof. O. Adewoye,** Director General National Agency for Science and Engineering Infrastructure (NASENI)

Lead Speakers:

i) **Dr. W.O. Siyanbola**
Director General
National Centre for Technology Management
(NACETEM)

ii) **Prof. G. C. Nwajiagu**
Director
Scientific Equipment Development Institute
Enugu

4:00p.m: Chairman's Opening remarks

4:05p.m:-6:00p.m: Paper Presentation and Discussions

7:00p.m: Rapporteur's Meeting

OTHER PAPERS	(10 MINS PAPER PRESENTATION)	SPEAKER(S)
3.	Development Trends and Applications of some Advanced Engineering Materials	C. Madu and A.O. Sodeinde
4.	New Developments in the Rubber Industry Assessing Synthetic Rubber by Measuring Tack Properties on a Glass substrate at varying contact time and debonding velocity	Prof. Ibrahim Sada
5.	Nigerian Capacity for Development of Advanced Engineering Materials	P.O. Babalola and A.O. Inegbenebor

Nigerian Capacity for Development of Advanced Engineering Materials

P.O. Babalola* **and A.O. Inegbenebor**

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The development of engineering materials as a discipline in the twentieth century was a direct response to demand for an interface between two isolated segments of society. One represented by society's need for products, the other by the availability of scientific methods and discoveries. The pace and success of technology are becoming more dependent on intersection with the social system and less on scientific discovery. In Nigeria we are at the cross road whether to use our resources to develop advanced engineering materials for our national development. This paper is addressing the question of whether or not we have the capacity to undertake projects on development of advanced engineering materials. Thus it examined this capacity in terms of human resources, infrastructure and appropriate technology. Highlighted in the paper are metallic and agro-waste materials as raw materials for the development. Moreover, aspects of appropriate technology such as open-mould and closed mould processes, vacuum (bag-autoclave process) and liquid metallurgy route are suggested as contributions for the acceleration and enhancement of Nigeria's development profiles. The paper concludes that Nigeria has the capability to develop advanced engineering materials. However, this is contingent on the provision of adequate funding and necessary facilities to competent qualified manpower that the tertiary institution can adequately supply.

Cost Reduction in Housing Delivery in the use of Natural Building Materials

C.C. Munonye

Department of Architecture, Anambara State University, Uli

The high cost of building materials results to the very high cost of housing delivery all over the world. This invariably made its affordability to the general population difficult, especially in developing countries where greater part of the population is classified as low income earners. Using Nigerian as an example, the percentage of people who do not have roof over there head in 1999 is put at 60% and the conservative estimated of low - income population is put at 90% (**Draft National Housing Programme, 2004).** It is also an established fact that the cost of building materials account for about 60% or more of the total cost of construction of a building. Unfortunately, most of these building materials in use are imported. This paper presents and discourses on the need for the natural building materials to be tapped and mass produced at cheaper rates, thereby making house affordable to the low income earners who form a greater number of our population.

Efficient Use of Nigerian Land Resources for Sustainable Food Production

Director,
Erosion, Flood and Coastal Zone Management
Federal Ministry of Environment, Abuja.

Various studies indicate that agricultural production will have to be increased if the rising world's

Nigerian Capacity for the Development of Advanced Engineering Materials

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ABSTRACT

This paper try to address the Nigeria capacity to develop advanced engineering materials in the line of availability of raw materials, human resources, infrastructure and appropriate technology. In conclusion, after dwelling on these topics, it was found out that Nigeria has the capacity to start to produce advanced engineering materials for national development.

1.0 Introduction

Nigeria as a nation is blessed with abundant of human and mineral resources. With our population over 140 million (1), and about 100 universities and many other tertiary institutions in the country, our ability to develop Advanced Engineering materials should not arise at all. The question that should come to mind is, whether the country is ready to venture into the world of advanced engineering material? This is the answer this paper will try to address in the modest way by outline our capacity as a nation to develop Advanced Engineering materials. Then what is advanced Engineering Materials?

They are either traditional materials whose properties have been enhanced or they are newly developed, high-performance materials and may cut across wide spectrum; metal, ceramics, glass, and polymers. These advanced engineering materials are used in high technology. Such materials can stand up to the high-temperature, highly radioactive environment of a nuclear reactor, the appropriate wear and equipment for the astronauts, heat-resistant ceramic tiles to enable the space shuttle to re-enter the earth's atmosphere without burning up, and semi conductors and multi-million chips for sophisticated computer circuits and telecommunications equipment are examples of such materials.

Without them, some of the greatest achievements we are witnessing in the developed world today would not have been possible. The development has been possible through the use of advanced engineering materials in form of composites, superconductivities, super alloys, polymers, ceramics, optic fibres, and semi conductors have revolutionized the developmental process in the world. These

*The correspondent author

products are used in communication, transportation, defence, building construction, medicine and dentistry, and sports.

The aim of this paper is to address the Nigerian capacity to develop advanced engineering materials in this twenty one century.

2.0 The Elements for Capacity that are necessary in the developing of Advanced Engineering Materials in Nigeria

The elements for capacity that are necessary in the developing of Advanced Engineering materials in Nigeria are: availability of raw materials, human resource, capital, infrastructure and appropriate technology.

2.1 Raw Materials Base

The criterion for the selection of types of advanced engineering materials production at any time include the availability of relevant raw materials that are available locally, or which can be feasibly imported from viable sources at competitive costs. As we know, reliability of raw material sources would minimise the chances for prolonged and costly underutilization of installed plant capacity for such production. Nigeria is richly endowed with metallic and non-metallic solid minerals.
A large number of these have been investigated and discovered to be suitable for commercial exploitation (2-4). Some of these abundant solid minerals which are the major element for advanced engineering materials production includes; Silicon, Magnesium, Bauxite, Titanium, Copper, Beryllium and Coal. Apart from non-metallic and metallic solid minerals, non-woody agricultural wastes such as coconut (*cocos nucifera*) fibres or coirs. To be able to convert the wastes of the coconut fibres into value added new materials is a scientific task. One of the promising alternative methods for achieving this, is by combining the fibres of the coconut wastes with materials of different characteristics such as plastics, to come up with a composite material having improved properties(5). In this case, fibres offer a number of advantages as reinforcing fillers in plastic composites, such as high specific strength and/ or stiffness, low weight, low cost and lower abrasion to processing equipment(6). Such synergistic combination of natural fibres, wood, thermoplastics, and their composites synthetic fibres can meet the demanding requirements for construction and transportation industries, namely for motor vehicle components(7). Nigerian has the advantage of having large deposits of coal of which carbon fibres can be obtained. Carbon fibres for these composites are produced mainly from two sources, polyacrylonitrile (PAN) and pitch, which are called precursors. In general carbon fibres are produced from PAN precursor fibres by three processing stages:-
1.Stabilization
2.Carbonization and
3.Graphitization
The table 1 can demonstrate the coal we have that will sustain our quest for the

production of advanced engineering materials.

Table 1 Some of the existing coal mines sites with reserves in Nigeria

S/N	Mine Location	State	Type of Coal	Estimated Reserves(Mil.T)	Proven Reserves(Mil.T)
1	Okpara Mine	Enugu	Sub-Bituminous	100	24
2	Onyeama Mine	Enugu	Sub-Bituminous	150	40
3	Ogwasuku-Azagba Obomkpa	Delta	Lignite	250	63
4	Lafia Obi	Nassarawa	Bituminous	156	21.42
5	Okaba	Kogi	Sub-Bituminous	250	3
6	Afuji	Edo	Sub-Bituminous	NA	NA

Table 2 Shows the principal raw materials for Advanced Engineering Materials that can be found in Nigeria with their product and the appropriate technology to be used.

Table 2 Existing minerals for the production of Advanced Engineering Materials

S/N	Minerals	Type of Products	Appropriate Technology
1	Bauxite	Metal Matrix Composites(MMC)	Liquid Metallurgy route
2	Silicon Carbide	Metal Matrix Composites(MMC)	Liquid Metallurgy route
3	Silicon	Chip, Ingot	Crystal Refining Method
4	Magnesium	Metal Matrix Composites(MMC)	Liquid Metallurgy route
5	Carbon	Carbon Fibres for reinforced plastics(CFP)	Vacuum Bag-Autoclave process
6	Coconut Fibres (Coir)	Fibres-Reinforced plastics(FRP)	Open-Mould:-Handlay-up process

2.2 Manpower

Besides the availability of raw materials, consideration must also be given to the

availability of labour-skilled and unskilled. Therefore, working on advanced engineering materials plant will require the services of the following mix of professionals working in different sections and units of the plant; engineers, technologists, technicians and artisans.
Nigeria has pools from which the manpower to run the production of producing advanced engineering materials can be taking from conveniently. They are the 98 Universities and many other tertiary institutions which are spread all over the county. From these 98 Universities, nine Nigerian Universities mount undergraduate and graduate programmes in metallurgical/materials engineering and another thirty run engineering programmes in mechanical, electrical, civil, computer, et cetera.
Each of the nine Universities has an average of 60 students per level. Thus, some 500 trained metallurgical and materials engineering graduates are materials engineering graduates are turned out every year of convocation by Nigerian Universities.
The technologists and others can be got from the four Polytechnics, which are running diploma programmes in metallurgy. We shall also remember that some Nigerians who finished up in various overseas Universities and Polytechnics come home for the National Youth Service Corps and take up employments. If these numbers of the overseas graduates and home finished graduates are added together there will be adequate manpower for the running of the advanced engineering materials plants in Nigeria.

2.3 Infrastructure

Adequate and efficient Infrastructural facilities and the supply of reliable utilities are advantage where advanced engineering materials industry can take off. These facilities and utilities include mainly transportation in form of railways, waterways, road networks, telecommunication, power and utilities.

2.3.1 Transportation

The current status of all transportation system the country needs to be upgraded to modern one. For example, the railway needs to be expanded to have double tracks, and should cover all the hooks and corner of the country. Any where the advanced engineering materials and finished products can be moved to the appropriate place. Nigeria has a reasonably good network of roads linking the major towns but they are in bad shapes. The communication system is reasonably good especially after the liberalization of the telecommunication industry.

2.3.2 Power and utilities

The provision of adequate and dependable supply of electricity and power and other sources of energy such as gas and coke remain important parameters in the operation and competitiveness of an advanced engineering materials plant. The present erratic supply of electricity to the public and industries is not good enough. The good news are that the governments are tackling this problem of the inadequate supply of electricity with seriousness, more power stations are being built all over the country.

3 Appropriate Technology

The availability of feasible and locally adaptable technology for attaining an acceptable efficient scale of operation is vital for a viable advanced engineering materials industry. The production of advanced engineering materials via these processes: the open-mould vacuum-bag-auto clave and liquid metallurgy route are the appropriate technology to be considered at moment.
There are many open-mould methods used for producing fibre-reinforced plastics. Some of the most important of these will now be discussed briefly.

(i) Hand lay-up process

This is the simplest, method of producing a fibre-reinforced composite. To produce a composite with this process is by using fibre glass and polyester, a gel coat is first applied to the open mould fibre glass reinforcement which is normally in the form of a cloth or mat is manually placed in the mould. The base resin mixed with catalysts and accelerators s then applied by pouring, brushing, or spraying. Rollers or squeegees are used to thoroughly wet the reinforcement with the resin and to remove entrapped air.

(ii) Spray –up process

The spray-up method of producing fibre-reinforced shells is similar to the hand lay-up method and can be used to make boat hulls, tube-shower units, and other medium to large-size shapes. In this process, if fibreglass is used, continuous-strand roving is fed through a combination chopper and spray gun that simultaneously deposits chopped roving and catalysed resin into the mould. The deposited laminate is densified with a roller or squeegee to remove air and to make sure the resin impregnates the reinforcing fibres.

Vacuum bag-Autoclave Process

This process is used to produce high-performance laminates usually of fibre-reinforced-epoxy systems. Composite materials produced by this method are particularly important for aircraft and aerospace applications.

Production of Metal Matrix Composite(MMC)

The base metal is properly cleansed and melts either in vacuum induction furnace or other furnace and reinforced particulates are added and stirred well before cast to the required shapes.

The other processes in the production of advanced engineering materials can be gradually installed as the country starts in manufacturing the product.

CONCLUSION

The endowment of Nigeria in the elements for the establishment of a viable advanced engineering materials industry in terms of raw materials, human resources, appropriate technology and infrastructure has been proven. It can be concluded that Nigeria should start producing advanced engineering materials now, because it is tomorrow materials.

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