

## **CHEMISTRY ADVANCED LABORATORY**

### **3.0 RESEARCH THRUST AND OBJECTIVES:**

The Chemistry Advanced Laboratory (CAL) was established with the mandate to make meaningful contributions towards the diversification of the economy by the application of the principles of Chemistry, in a sustainable manner, to add value to our abundant natural resources, and produce a variety of consumer materials. In order to actualize its research thrust, its mission is set out in the following objectives:

Boost agriculture by the production of environmentally friendly agricultural inputs.

Develop process technologies for the beneficiation of some solid mineral ores for the production of a variety of industrial raw materials and products.

Develop drugs materials and supplements from locally available medicinal plants for the treatment of some major diseases.

Conduct research and development on nanomaterials, composite inorganic and organic materials for the production of materials with advantageous properties (e.g. chemical, mechanical, physical, electrical and thermal).

Evaluate the environment for pollution minimization, remediation and elimination.

Provide facilities for human resource development through training in various techniques of pure and applied Chemistry.

Provide high quality analytical laboratory services for the determination and characterization of environmental, agricultural, petroleum and medicinal samples.

### **3.1 CURRENT AND PLANNED RESEARCH ACTIVITIES**

#### **3.1.1 CURRENT RESEARCH**

Current research activities of CAL are targeted at aspects of agricultural chemistry, solid minerals processing, organic/natural product chemistry and analytical and environmental chemistry.

- i In the agricultural chemistry project the purpose has been to minimize the rapid hydrolysis of urea fertilizer and ensure that on application, nitrogen will be made available to the plant throughout the planting season. Partially hydrolyzed maize cob waste is combined with urea by solid-state treatment at a predetermined temperature.
- ii Technologies for extraction and purification of mineral ores for the production of some industrial raw materials such as sulphur, oxides, pharmaceutical and other grades talc, and some basic chemicals are being developed.
- iii Studies are on for the production of active principles or preparation of food supplements from locally available medicinal plant for the treatment of major diseases such as epilepsy, diabetes and HIV/AIDS.

- iv Ion-selective electrode determination of fluoride levels in water and a variety of infant food products is being carried out with a view to elucidating factors that could lead to greater exposure of children of primary school age to the anion. It is hoped that this should help in mitigating the prevalence of dental fluorosis among this target group in the FCT. Analytical monitoring of lead in water samples is also being done in view of the occurrence of galena (lead sulphide ore) in the Gwagwalada Area Council of the FCT.

### 3.1.2 PLANNED RESEARCH ACTIVITIES

- i **Organic and Natural Product Chemistry:** Extraction, separation and molecular characterization of active principles from locally available medicinal plants; synthesis of biologically active and environmentally friendly substances
- ii **Polymer Chemistry:** Synthesis of, and characterization of chemically recyclable and biodegradable polymers.
- iii **Materials Chemistry:** Preparation of new inorganic and biocompatible materials – biologically non-hazardous fibrous materials, coatings for use in joints and dental roots; inorganic films with thermal-electric characteristics, catalytic activity and corrosion resistance. Magnetic carbon materials for possible use as magnetic toners for copiers and similar machines, and catalysts for a variety of reactions.
- iv **Analytical/Environmental Chemistry:** Detection and determination of organic and inorganic pollutants; speciation studies; development of pollution prevention and remediation techniques.

### 3.2 ACHIEVEMENTS

- i. Kilogram quantities of a slow-releasing nitrogen fertilizer, which is more environmentally friendly and efficient than the conventional urea-fertilizer have been produced. Field evaluations of the product are being carried out following successful greenhouse trials.



**Slow release nitrogen Fertilizer**

- ii. Process technologies have been developed for the production of pharmaceutical grade talc, sulphur, lead oxides, haemetite, ferrous/ferric sulphates, and ferric oxide from appropriate impure ore deposits



**POP**

**Pharm Talc**

**Sulphur/Lead oxides**

- iii Prepared supplements from our natural products chemistry laboratory are being tested for their efficacy.
- iv Analytical laboratory services and environmental samples evaluation are being executed using equipment such as:
  - Fourier Transform - Infrared spectrometer (FT-IR)
  - Atomic Absorption Spectrometer (AAS)
  - High Performance Liquid Chromatography (HPLC)
  - Gas Chromatograph - Mass Spectrometer (GC-MS), among others.



**Gas Chromatograph/Mass Spectrometer**

### **3.3 COLLABORATING ORGANIZATIONS**

The Chemistry Advanced Laboratory collaborates with various national and international agencies in the performance of its R&D functions. Some of the organizations include:

- i Raw Materials Research and Development Council, Abuja, Nigeria.

- ii Chemistry Department, University of Abuja, Abuja, Nigeria.
- iii Department of Chemistry at the University Bologna, Bologna, Italy.

### 3.4 PATENTS IN- VIEW

It is hoped that our work on the slow releasing nitrogen fertilizer and medicinal supplements may lead to acquisition of patents when completed.

### 3.5 PROFILE OF THE DIRECTOR



Professor S. A. Thomas, a professor of Chemistry is the current and pioneer Director of the Chemistry Advanced Laboratory.

Prof. Thomas graduated with a B.Sc. First Class Honours degree in Chemistry from the Ahmadu Bello University, Zaria, Nigeria in 1975, and obtained a Ph.D in X-ray Diffraction studies of some organic and inorganic molecules in

1979 from the University of Sussex, Brighton, England. Prior to his assumption of duty at SHESTCO, Professor Thomas taught and researched at the Ahmadu Bello University, Zaria. He has published extensively at home and abroad in the areas of structural Chemistry, analytical and environmental Chemistry. He is a Fellow of the Chemical Society of Nigeria, and also holds membership of many other reputable professional bodies.