

**Report on the
AFRA Workshop on Environmental Analytical Chemistry
Arusha-Tanzania, 23-24 May 2011**

Co-organized between International Atomic Energy Agency (IAEA), International Organization for Chemical Sciences in Development (IOCD) and Tanzania Atomic Energy Commission (TAEC)

Background

Africa has the highest rate of population growth and urbanization in the world. Currently, 38% of Africa's population is living in urban areas. It is estimated that by 2030, 54% of its population will be in the urban areas. Because of the increased urbanization, the rise in vehicle emissions and the trend towards greater industrialization, urban air quality in the continent is worsening. In many countries, the use of leaded gasoline is still widespread and vehicle emission controls are nonexistent. A large number of African countries have begun to adopt air quality management legislation, regulations, or policies as a consequence of the high concentration of air pollution, particularly in the large cities, and its adverse effect on human health. Other countries are recognizing the need for improving air quality and moving to control emissions. The active involvement of the environmental quality management agencies in the African countries is an indication of their interest in improving air quality, particularly to demonstrate that the new control measures are having their intended effects and that specific sources of pollution are being reduced as control measures are introduced.

The awareness of air pollution has led to numerous studies on the chemical composition of ambient aerosols and the determination of pollution sources. Atmospheric aerosols influence many atmospheric processes including cloud formation, visibility variation and solar radiation transfer, and play a major role in the acidification of clouds, rain and fog. Both gaseous pollutants (including sulphur dioxide, particulate matter, carbon monoxide, reactive hydrocarbon compounds, nitrogen oxides), and atmospheric aerosols (including trace amounts of heavy metals) can degrade the air quality.

The availability of a long-term, high-quality record of Air Particulate Matter (APM) concentrations, in particular, and resulting source apportionments can serve as a substantial part of the accountability assessment. In order to obtain significant improvements in air quality across the region, it is necessary to understand the impacts of both local and regional pollution sources. Further on, the availability of coordinated data from the region could provide more reliable estimates of cross-boundary transport, particularly during high pollution episodes. Non-destructive nuclear and related analytical techniques such as neutron activation analysis (NAA) and X ray fluorescence analysis (XRF) have already proved to be well suited for the routine analysis of aerosols samples. They provide multi-element capability needed in creating databases to be used for assessing air pollution, source apportionment or time-trend assessments. In addition, their ability to quickly and efficiently produce large data sets for statistically characterizing and fingerprinting pollution sources as well as estimating different source contributions is critical to understand air pollution. These techniques, along with other multi-element destructive ones such as inductively coupled plasma (ICP) - mass spectrometry (MS) or ICP - atomic emission spectrometry (AES), indeed provided the bulk of analytical data presented during the workshop.

Under the regional IAEA/AFRA project RAF4019 - *Developing Air Pollution Monitoring in Urban Zones*, the IAEA has been assisting participating Member States to develop capacity for urban air pollution control. The objectives of this project were to elucidate and enhance the understanding of national and trans-boundary sources of air pollution in urban zones; to develop an accurate

representation of transported pollutants across national boundaries; and to provide the basis for the development of effective and efficient air quality management strategies to improve air quality.

The Workshop on Environmental Analytical Chemistry for Air Pollution Monitoring was held in Arusha, Tanzania, from 23 to 24 May 2011. It was organized by Tanzania Atomic Energy Commission with support from the Government of United Republic of Tanzania, International Atomic Energy Agency (IAEA), African Regional Cooperative Agreement on Research, Development and Training related to Nuclear Science and Technology (AFRA) and International Organization for Chemical Sciences in Development (IOCD).

The Workshop objectives were to:

- Provide understanding and state of the art information about the environmental analytical chemistry role in air pollution. In particular, chemistry–climate interactions and the transformation, processing, deposition and composition of anthropogenic and natural pollutants were tackled and discussed;
- Offer a forum for discussions between participants from the African Member States about national and trans-boundary sources of air pollution in urban zones;
- Supply a platform and facilitate exchange of information and experience about development of effective and efficient air quality management strategies to improve air quality.

Results of the workshop

The workshop included a broad tutorial thematic by invited experts in order to guide newcomers and provide advanced knowledge to experienced researchers how to properly design an air sampling campaign, which kind of materials and equipment to use, and what information may be obtained from the survey. Various methods of sampling and measurement of APM and gases in urban atmosphere for regulatory monitoring were presented and discussed. Emphasis was given to the advantages of nuclear analytical techniques for APM analytical characterization and novel approaches like the use of Micro PIXE for 3D element specific imaging of APM particles were presented. Several methodologies for data interpretation have been explained in detail, from relatively simple graphic to more sophisticated mathematical and statistical models. In addition, emphasis was given to the importance of receptor modeling (like Positive Matrix Factorization “PMF”, Factor Analysis “FA”, Chemical Mass Balance “CMB”) as a tool for APM source apportionment. The lectures of invited speakers explored the role of the environmental analytical chemistry in air pollution and topics like the chemistry of precipitation were targeted and discussed in detail.

The participants from African IAEA member states reported on the analytical results achieved after systematic air sampling campaigns conducted in Africa urban sites, in assessing air pollution impact, as well as outlining the efforts of various government and research institutions to develop this field for air quality improvement in Africa continent. Finally, the workshop emphasized the necessity of exchange and sharing information about development of effective and efficient air quality management strategies to improve air quality in Africa. It has been concluded from the workshop that although considerable efforts have been undertaken by few African countries to establish and implant air quality monitoring and management, most of countries still need a lot of support and assistance.

After the workshop, seven manuscripts from Algeria, Burkina Faso, Ghana, Madagascar and Morocco were submitted to IAEA and currently an evaluation internal IAEA process is in progress towards the approval of the proceedings volume as an IAEA Technical Document. The manuscripts categorized under a specific Theme, entitled: “Assessing Air Pollution and its Impacts in Africa Urban Zones”,

provide rich analytical information on the compositional profile of fine and coarse air particulate matter from different African urban areas (Algiers, Ouagadougou, Accra, Antananarivo, Meknes and Kenitra), conducted after systematic sampling campaigns. It is hoped that the workshop proceedings volume will help to elucidate national and trans-boundary sources of air pollution and to explore and better understand the role of environmental chemistry related interactions in the air-pollution levels of African urban areas.

PROGRAM

Monday 23 May 2011		
Time	Lecturer	Title
08:30 – 09:00	Registration	
09:00 – 09:10	Welcome to the participants – Mr. BANZI, Tanzania Atomic Energy Commission (TAEC)	
09:10 – 09:15	Opening Remarks – Mr. KARYDAS, Andreas, IAEA	
09:15 - 09:20	Opening Remarks – Mr. VAN GRIEKEN, International Organization for Chemical Sciences in Development (IOCD)	
09:20 - 09:30	Official Opening – By DG-TAEC/NLO	
	Session I: Chair person: Mr. BOUNAKHLA	
09:30 – 10:00	Mr. KARYDAS, Andreas – Germanos, <i>International Atomic Energy Agency, Nuclear Spectrometry and Applications Laboratory, Physics Section –NAPC, Vienna, Austria</i>	The IAEA activities related to the applications of nuclear analytical techniques for environmental monitoring
10:00 – 11:00	Mr. VAN GRIEKEN, René Ernest, <i>University Antwerpen, Department of Chemistry Antwerpen, Belgium</i>	XRF and nuclear based analysis methods for atmospheric particles
11:00 – 11:30	<i>Coffee Break</i>	
11:30 – 12:30	Mr. TUNCEL, Gürdal Süleyman, <i>Middle East Technical University, Faculty of Engineering, Department of Environmental Engineering, Ankara, Turkey</i>	Receptor modeling as a tool for source apportionment: Part 1, FA, PMF and CMB
12:30 -14:00	<i>Lunch break</i>	
	Session II: Chair person Mr. VAN GRIEKEN	
14:00 - 14:40	Mr. BELAMRI, Mohamed, <i>Division of the nucleonics, Nuclear Research center of Algiers, Algeria</i>	Use of nuclear techniques to study the impact of air pollution by heavy metals on Algiers urban centre
14:40 – 15:20	Mr. NABAYAOGO, Delwendé, <i>Autorité Nationale de Radioprotection et de Sûreté Nucléaire (ARSN), Ouagadougou, Burkina Faso</i>	Urban air quality monitoring in Ouagadougou: NO ₂ , SO ₂ , CO and particles measurements
15:20 - 15:30	<i>Coffee Break</i>	
15:30 – 14:30	Mr. TUNCEL, Gürdal Süleyman, <i>Middle East Technical University, Faculty of Engineering, Department of Environmental Engineering, Ankara, Turkey</i>	Sampling and measurement of particles and gases in urban atmosphere for regulatory monitoring.

Tuesday 24 May 2011,		
Time	Lecturer	Title
	Session III: Chair person Mr. NABAYAOGO	
09:00- 10:00	Mr. TUNCEL, Gürdal Süleyman, <i>Middle East Technical University, Faculty of Engineering, Department of Environmental Engineering, Ankara, Turkey</i>	Receptor modeling as a tool for source apportionment: Part 2, Supplementary techniques
10:00 – 10:40	Mr. ABOH, Innocent Joy Kwame, <i>Ghana Atomic Energy Commission National Nuclear Research Institute, Legon, Ghana</i>	Monthly variations of ambient air particulate matter levels at Kwabenya and Ashaiman in the Greater Accra region of Ghana
10:40 – 11:00	<i>Coffee Break</i>	
11:00 - 11:40	Mr. ANDRIAMAHENINA, Njaka Namelantsoa, <i>Ministère de l'éducation nationale et de la recherche scientifique (MENRS), Institut national des sciences et techniques nucléaires (INSTN), Antananarivo, Madagascar</i>	Air pollution studies in term of lead, PM2.5, PM2.5-10 and PM10 in urban area of Antananarivo
11:40 – 12:20	Mr. BOUNAKHLA, Moussa, <i>National Center of Energy, Sciences and Nuclear Techniques (CNESTEN), Rabat, Morocco</i>	Chemical characterization of fine and coarse air particulate matter in the Kenitra's city (Morocco).
12:20 – 14:00	<i>Lunch break</i>	
	Session IV: Chair person Mr. RAMADAN	
14:00 – 14:40	Ms TAHRI, Mounia, <i>National Center of Energy, Sciences and Nuclear Techniques (CNESTEN), Rabat, Morocco</i>	Emission Sources and Air Quality Evaluation in Meknes's city (Morocco)
14:40 – 15:10	Mr. KARYDAS, Andreas – Germanos, <i>International Atomic Energy Agency, Nuclear Spectrometry and Applications Laboratory, Physics Section –NAPC, Vienna, Austria</i>	Recent Micro PIXE advances for 3D element specific imaging of APM particles
15:10 – 15:30	<i>Coffee Break</i>	
15:30 – 16:30	Mr. TUNCEL, Gürdal Süleyman, <i>Middle East Technical University, Faculty of Engineering, Department of Environmental Engineering, Ankara, Turkey</i>	Chemistry of precipitation in the eastern Mediterranean atmosphere: neutralization, trends and fluxes
15:30 – 16:30	Mr. ABOH, Innocent Joy Kwame, <i>Ghana Atomic Energy Commission National Nuclear Research Institute, Legon, Ghana</i>	Quality Assurance and Quality Control methods applied in Aerosol Analysis
17.00– 17:30	Concluding Remarks: Mr. Rene Van Grieken, Mr. Karydas and URT Official	