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RMCC Cross Calibration Meeting

***CABILITIES, ACTIVITIES and QA/QC
in radiation measurement laboratory at JAEC***

Dr. Mamoun Makahleh
Abu Dhabi
October 29, 2015

LABORATORIES



GAMMA SPECTROSCOPY LABORATORY

The main task of the laboratory is the measurement of radioisotopes from different sample matrices (soil, food, filters, water) for the purposes of measuring gamma emitters. The average through output of the laboratory is about 15 sample per day from export and import product in addition to the samples for environmental monitoring and research.

For the purpose of measurements different spectroscopy systems are used:

- System with 15% HPGe detector from Canberra
- System with 40% HPGe detector from Canberra
- System with 20% HPGe detector from Canberra
- System with 50% HPGe detector with 42 sample changer from Ortec
- In addition to several portable systems for field measurements

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INTRODUCTION



The research of the department is primarily based on competences in radiation physics, radiation chemistry, analytical chemistry radioecology, and nuclear measurement techniques and methods.

The research and development work of the department is carried out in close co-operation with Jordanian universities and research institutes . The department participates in national and international research programmes including the IAEA research programmes .

The department organization include the following scientific aspects :

- Radiation Physics (Gamma spectroscopy, Radon measurements and neutron activation)
- Radiation Chemistry (Alpha spectroscopy, beta counting, gross alpha/beta and isotopes separation and extraction)
- Dosimetry (personnel and industrial dosimetry, SSDL).
- Analytical Chemistry (ICP-MS, ICP-OES, Titration and FTIR measurement technique).

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LABORATORIES


PERSONAL DOSIMETRY LABORATORY (PDL)

Provide radiation protection services to the 1325 radiation workers in 160 hospitals and different national institutes and companies using:




- Total body dosimeters.
- Finger dosimeters.
- Neutron dosimeters.
- Pocket dosimeters.



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LABORATORIES

Radiochemistry laboratory

The main task of the laboratory is the separation of radioisotopes from different sample matrices (soil, food, filters, water) for the purposes of measuring alpha and beta emitters such as:
(U-238,234, Pu-238,239, Am-241, Sr-90, Po-210)

The services provided by this laboratory are as following:

- Preparation of more than 150 imported food samples yearly.
- Preparation of 50 milk samples for export
- Preparation of more than 100 samples monthly (soil, food, milk, water, grass, leaves and air filters) for environmental monitoring inside and out side the location of research reactor .
- Preparation of 120 samples from the gulf of Aqaba for determination of sedimentation rate , contamination from heavy shipments and .industry

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LABORATORIES

Secondary standard Calibration laboratory. (SSDL)


Provide calibration services for more than 20 company and institutes from public and privet sector where they used radiation measurement devices such as:

- Survey meters.
- Radiation gages and NDT at industry
- Ionization chambers and dose calibrators at the hospitals.


The laboratory is equipped with All the necessary tools, phantoms and devices for providing quality control services to the hospitals in the field of radio diagnostic Radio therapy, nuclear medicine and Mammography .



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The process in the Analytical Chemistry Lab. Is as following


Chemical Sample Preparation.




Clean room and final Preparation.



Measurements by ICP-OES or/and ICP-MS






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LABORATORIES

Analytical chemistry laboratory

ICP-MS & ICP-OES

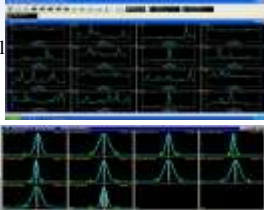


ICP-MS and ICP-OES can be used for a wide variety of Applications

- Environmental
- Metallurgical
- Biological
- Petrochemical
- Geological
- Clinical
- Semiconductor industry

Using the ICP technique up to 75 elements can be measured with concentrations down to 1 part per trillion.

The laboratory was established at the second half of the year 2010 and used for measurement of more than 1000 samples for JERI company and 20 samples for RIO Tinto company and 70 samples for extraction department during the last three weeks in addition to the several hundreds PT, check, research and environmental samples



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LABORATORIES

Physical Sample Preparation Laboratory

```

    graph TD
      Log[log] --> Drying[Drying]
      Drying --> Moisture[Moisture content]
      Moisture --> Grinding[Grinding]
      Grinding --> Sieving[Sieving]
  
```

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LABORATORIES

Alpha / Beta spectrometry and gross alpha / beta laboratory.

The laboratory was used to measure more than 500 food and water samples prepared by radiochemistry in addition to international PT samples

The laboratory develop a rapid and economic method for direct extraction and measurements of uranium using the Liquid Scintillation Counter with 360 sample capacity autosampler.

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Neutron Applications:

- Neutron Shielding.
- Fast Neutron Spectroscopy.
- Slow Neutron Spectroscopy.
- Calibration of neutron Survey Meters.
- Irradiation of neutron personal dose monitors (TLD's).
- Delayed Neutron Activation Analysis (DNAA).
- Prompt Gamma Neutron Activation Analysis (PGNAA).


Neutron Lab Achievements:

- Build Shielding Houser for Cf-252 neutron source.
- Build In-House control system for safe handling of the neutron source.
- Prepare shielding materials to make neutron shielding and moderation experiments.
- Provide 8 weeks training for students from nuclear engineering section at JUST.
- Provide facility for neutron laboratory for students from nuclear engineering section at JUST.
- Help students from nuclear engineering section at JUST make Graduation Projects (Neutron Shielding and Neutron Dosimetry).

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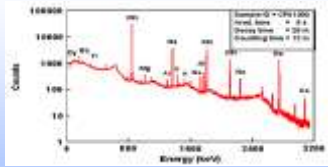


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LABORATORIES


Neutron activation laboratory

<p>Neutron-Shield System</p> 	<p>Control and Monitoring Systems</p> 	<p>Neutron Shielding Materials</p> 
		<p>Activation Foil</p> 
		<p>Neutron Shielding Materials in Holder</p> 
<p>Gamma Spectrum of Neutron Activated Sample</p> 		<p>Fast Neutron Detector</p> 
		<p>Neutron Dose Measurement</p> 

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LABORATORIES

Polymers laboratory




The laboratory is equipped with different tools and devices for testing the physical and mechanical characteristics of polymer materials and is used for research and study the effects of radiation to improve these characteristics. The laboratory was used from several researchers and PhD students from Jordan Un. , Al-Albeet Un. And Al-Yarmuk Un. Also the laboratory was used to design and create a modules for moderators and attenuators for neutron activation analysis.


Impactor




Melt Flow Tester




Melt Flow Tester




Sample Preparation



Tensile




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LABORATORIES

Nuclear instrumentation and training laboratory



1. **Nuclear instrumentation workshop:**
The workshop provide preventive and maintenance services and electronic calibration for all laboratory using very sophisticated tools and test devices .
The workshop design and implement several tools , devices and upgrades used in different laboratories. As an example
 - Upgrade the auto sampler for gamma system from 16 samples to 42 samples including the software, the sample holder and sample tray
 - Upgrade the autosampler for ICP-OES to hold and manipulate 50 mL samples instead of 10 mL samples
 - Design and implement a tool for Po-210 measurements.
2. **Training:**
 - Establishment of a routine course on radiation protection first level for radiation workers from public and privet sectors
 - Provide a specialize courses on different aspects of radiation measurements by request
 - For the last three years we provide 8 weeks training for the students from nuclear engineering section at JUST Un. In addition to the once a week exercise using NA facilities during the semester.
 - For the recent year we provide fellowship training for 8 fellows from Palestine , Iraq and Yemen for duration of two to three months through IAEA
 - Provide training for B.Sc and M.Sc students from different national Un's.

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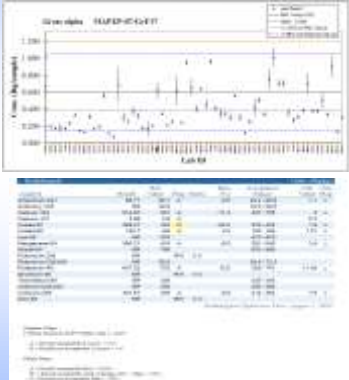
QA/QC and Performance Evaluation Results.

1. Proficiency Testing (PT)

The laboratories participated yearly in several PT programs (USA MAPEP , International ALEMERA network and IAEA programs).

The results from these tests put our laboratories in advanced position between hundreds of the world wide laboratories regarding the number of measured elements and the accepted results.

As consequence of good performance our laboratories are included in the USA trade book for radioactive determination and isotope identification for the purpose of trade with USA. In addition to that our laboratories was accepted as a member of ALMERA network for the emergency situations in the word as we participate in determination and identification of contaminants after Fukushima accident and we participate in international meeting for decision of the results and our results were in a very good correlation with international results.



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QA/QC and Performance Evaluation Results.

The laboratories follow a quality control procedures for monitoring the validity of tests and calibrations undertaken. [Quality management](#)

- ✦ The accuracy and reproducibility of measurement systems were verified on a periodic basis
- ✦ regular use of **certified reference materials** and/or internal quality control using secondary reference materials;
- ✦ Participation in **interlaboratory comparison and proficiency-testing** programmes with good results.
- ✦ **replicate tests** and calibrations.
- ✦ Preparation of local standard reference material samples . [SRM JAECO1](#)


Intercomparison measurements and proficiency tests are the best mechanisms to show overall performance of the laboratory work

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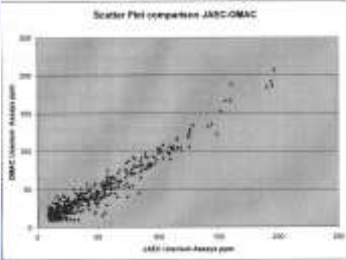


Performance Evaluation Results

2. Inter-Laboratory Comparison



- The results from measurements of 482 samples in duplicate (350 pore hole samples and 132 bulk trench samples) for RIO Tinto company indicate a very good correlation between our results and OMAC laboratory results


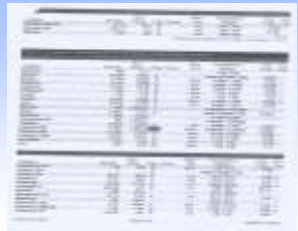

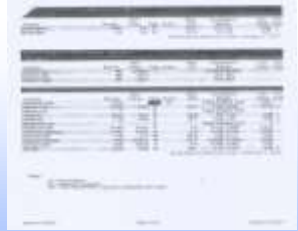


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Performance Evaluation Results

3. ISO 17025 Accreditation

CERTIFICATE OF ACCREDITATION

JORDAN ATOMIC ENERGY COMMISSION (JAEC)
RESEARCH (LABORATORY) AND INNOVATION DIRECTORATE (RID)

SCOPE OF ACCREDITATION

Field of Testing	Methods	Standards	Notes/Remarks
Chemical Analysis	ISO 17025	ASTM E1110, ASTM E1111, ASTM E1362, ASTM E1554, ASTM E1855, ASTM E2112, ASTM E2922, ASTM E2957, ASTM E3045, ASTM E3088, ASTM E3199, ASTM E3200, ASTM E3280, ASTM E3290, ASTM E3311, ASTM E3320, ASTM E3330, ASTM E3340, ASTM E3350, ASTM E3360, ASTM E3370, ASTM E3380, ASTM E3390, ASTM E3400, ASTM E3410, ASTM E3420, ASTM E3430, ASTM E3440, ASTM E3450, ASTM E3460, ASTM E3470, ASTM E3480, ASTM E3490, ASTM E3500, ASTM E3510, ASTM E3520, ASTM E3530, ASTM E3540, ASTM E3550, ASTM E3560, ASTM E3570, ASTM E3580, ASTM E3590, ASTM E3600, ASTM E3610, ASTM E3620, ASTM E3630, ASTM E3640, ASTM E3650, ASTM E3660, ASTM E3670, ASTM E3680, ASTM E3690, ASTM E3700, ASTM E3710, ASTM E3720, ASTM E3730, ASTM E3740, ASTM E3750, ASTM E3760, ASTM E3770, ASTM E3780, ASTM E3790, ASTM E3800, ASTM E3810, ASTM E3820, ASTM E3830, ASTM E3840, ASTM E3850, ASTM E3860, ASTM E3870, ASTM E3880, ASTM E3890, ASTM E3900, ASTM E3910, ASTM E3920, ASTM E3930, ASTM E3940, ASTM E3950, ASTM E3960, ASTM E3970, ASTM E3980, ASTM E3990	
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