

Reality of Nanotechnology in Jordan:

In Jordan there is considerable interest in the development and production of nanotechnology; where many institutes were established such as: “Nanotechnology Research Center “at the Jordan University of Science and Technology / Irbid, and Hamdi Mango Center for Scientific Research at the University of Jordan in Amman, in addition to the Royal Scientific Society. There are also many different efforts in Jordanian universities in scientific research on nanotechnology. At least, 200 scientific publications were published in the field of nanotechnology.

Priorities with regard to the management of nanomaterials in Jordan

Industry:

Currently, no accurate statistical information is available on the number of industrial facilities that uses nano-materials in their industries due to the following:

- 1 - The recent development of nanomaterials is not well understood or recognized in statistical terms.
- 2 - Jordanian factories use imported raw materials in the form of nano-particles.
- 3 – The lack of sufficient awareness and development of nanomaterials.
- 4 - The raw materials containing ultrafine particles are more expensive than the usual raw materials.

There are many industries in Jordan that deal with nanomaterials that can be summarized as follow:

- 1- A primary components for the manufacture of
paints (calcium carbonate, kaolin, bentonite).
The pharmaceutical industry and cosmetics.
- 2 - as a product of the mining industries such as:
Jordanian phosphate.
Cement.
Roack and Stone quarries
Marble and granite

National legislative instruments for the management of Nanomaterials

Currently, there are no rules or legislation in Jordan dealing with nano-materials, but in principle these materials can be subjected under the laws and legislation for chemicals.

The responsibilities of different local authorities regarding to the nanomaterials management.

At this moment, poor activities and responsibilities regarding to the nanomaterials and nanotechnology issues been carried out by different local and national authorities such as Ministry of Environment, Ministry of Health, Ministry of Agriculture, Ministry of Industry and trading, Jordan Institution for Standards and Metrology, research institutes and universities. This is due to the lack of information and knowledge regarding nanomaterials manegment. However, these authorities will be more focused and active if this issue got a higher concern at the national level at recent time, these responsibilities can be summarized as bellow:

- Establishing a database about nano-materials used, existing locally, imported as well as the users.

- Control of products containing nano-particles, whether imported or locally produced.
- Develop guidelines to deal safely with this technology.
- Development of legislation for the use of these nano-materials in Jordan.
- Disposal of waste resulting from dealing with this technology in environmentally safe ways.

The responsibilities of different non-state actors regarding to the nanomaterials management.

Due to lack of experience and poor information about nanomaterials and nanotechnology, the situation for the non state sector is similar to the government sector as mentioned above. , however, the expectation from this sector can be addressed as follows:

- Educate citizens, especially workers in various sectors that use nanotechnology.
- Contribute to the support and development of scientific research on nanotechnology

Expertise available outside the government sector

Some parties outside the government sector plays an important role in the management of nanomaterials such as:

1 - University of Jordan

- Hamdi Mango Center for Scientific Research Was created at the University of Jordan in 1999 by a generous donation from the late Ali Mango. in the year 2009, the center starts to fund contribute to the scientific research in nano fields.

- The College of Science at the University of Jordan is one of the important research centers in the Kingdom and especially in the field of nanotechnology, this is due to availability of human resources as well as the scientific instruments, such as: Field Emission Scanning Electron Microscope (FEI), Atomic force microscopy (AFM), XRD, XRF and Xray single crystal.

2 - University of Science & Technology

In 2009, the University of Science and Technology began the initial steps to establish a Nano-Technology Center in collaboration with the University of Illinois - Urbana Champaign U.S. This center will serve three main purposes:

- Create a scientific base of research in the fields of nanotechnology
- Establish joint programs in research, development and innovation
- Establish cooperation with companies and industrial enterprises to produce and develop products for the local and global markets.

3- Atomic Energy Commission:

Electron accelerator project (SESAME Synchrotron) was built in Allan, Salt where more than 80% of infrastructure and beam lines were completed. This device is used to diagnose the characteristics of optical, electronic and molecular structure of the nanomaterials used in various fields. In addition, the body is found in devices used to diagnose the constituent elements of nanomaterials.

Jordanians research efforts in nanotechnology:

Despite the limited material resources and logistics capabilities, researchers were able to use the techniques of Jordanians Nanotechnology in the following applications:

1 - computer operations: registration of a patent relating to detailed designs for a new computer circuits critical technology uses carbon tubes nanometric "Carbon Nanotubes" within nanometric dimensions. The importance of this research in the manufacturing of robotic devices nanomedical for possible future use in the fields of medical and military

2 - Systems Biology: Record a research team Jordanian patents in the field of Nanotechnology and its applications in systems biology. Thanks to the invention group was able to produce micro-magnetic multiple items from the fly ash from the hearths, iron and steel plants have been used in the rapid detection of pathogenic bacteria in water sources and disposal of them, and characterized the results are promising in the fight against cancer.

Nanoparticles waste

Nano-particles waste in Jordan can be divided into two categories:

- Natural sources, such as volcanoes, storms, desert sand
- Artificial sources, such as cement plants, industrial and mining factories,

Nano-particles waste can present in air, soil and water .

- Waste present Air:

Recently, monitoring of gaseous air pollutants and dust particle are in the micron size only, detection of nano-waste is not listed under any international or local standards for air quality.

Ministry of Environment is currently monitoring air quality through three projects are distributed as follows:

- Study the levels of gases in the area of Jordan (Al-Zarka) to monitor plant emissions of heat-emitted from Al- Hussein electric Station and Alkhirbeh Alsamra.
- There are five monitoring stations in industrial sites: 1 - Amman 2 - Balqa (Cement Fuheis) 3 - Alzarka (Alrusaifeh) 4 - Mafraq 5 - Tafila (Alrashadih).
- There are three monitoring stations in the industrial cities: Karak, Amman and Irbid.
- The Aqaba Special Economic Zone Authority is currently monitoring all levels of toxic emissions

- Waste present in the soil:

There is no tests in Jordan to monitor the contamination of soil in the nano-scale level.

The nano waste in the soil might be from the sediment that comes from the air or the irrigation, rainfall and floods

- Waste present in the water:

There is no standard specification for measuring nanomaterials in water. The Ministry of Environment in the collaboration with the Ministry of Water, is currently monitoring water quality in the Jordan in five sectors::

- Ground water, springs and artesian wells.
- Floods and valleys of a flood.
- Water Dams
- Traditional water (domestic wastewater) by observing the 33 stations of which 22 are under the authority of water and 11 belonging to the private sector.
- Industrial waste water:

Analysis:

Jordan still in the initial phases of dealing with nanotechnology, it requires time and infrastructure as well as technical and financial resources in order to achieve an advanced level in the world. Therefore it requires encouraging studies and research for measuring the severity of nanomaterials on human health and their impact on the environment different. There must be

technical laws that enable all stakeholders to monitor nanomaterials and to ensure their compliance with the Jordanian standards.

- There is no national umbrella to manage and coordinate national efforts in this area.
- Jordan lacks legislation on safe management and handling of nanomaterials
- lack of sufficient awareness of nanotechnology for the working staff in relevant government agencies (Ministry of Health, Ministry of Environment, Ministry of Agriculture, Ministry of Industry and Trade, the Customs Department of Jordan, etc. ..)
- lack of sufficient awareness and knowledge of workers in the private sector, whether factories or companies.
- lack of a database of nano-materials with the relevant authorities to enable them to deal easily with this technique.

Recommendations:

- Establish a national umbrella to manage and coordinate national efforts in the field of nanotechnology
- Amending legislation and laws in line with the development of nanotechnology.
- Launching awareness workshops for technical staff operating in the relevant authorities (Standards and Metrology, founder of the Food and Drug Administration, the Customs Department of Jordan)
- to set up proper rules that determine the technical specifications of nano-materials.
- to establish real database on products containing nanoparticles.
- Support national capacity to deal with nanotechnology.