NUCLEAR APPLICATION IN THE REPUBLIC OF KAZAKHSTAN

Kurchatov 2013

Introduction

The development of nuclear and radiation technologies is one of six priorities announced by our government in the "National Program of Innovative Development".

Application of researching reactors and cyclotrons for technological purposes have been developing in our country for a quite long period – from the beginning of 80th of the last century on the base of installation of National Nuclear Center and later in the Park of Nuclear Technologies, which was found specially for the promotion of nuclear and innovative technologies.

Radiation sterilization was the first ad up to now high-demanded way of medical products treatment. Artificial radioactive isotopes and radiopharmaceuticals production, polymers processing by electron beam, track membranes production and so on – these are incomplete list of the technologies applied in our republic to say nothing about radiation application for non-destructive testing and science.

WWR-K Research Reactor

A thermal neutron pool-type reactor. Coolant, moderator and reflector – desalted water.

Commissioned in 1967, operated at thermal power of 10MW till 1988 without deviations.

In period 1988 to 1998 the work was performed to enhance safety under high seismicity conditions (calculations and validations, structure strengthening, doubling of safety-related systems, execution of new documentation).

Since the core configuration was changed the thermal power was reduced to 6 MW without loss of neutron flux.

TECHNICAL PARAMETERS

Thermal power	6 MW
Loading ^{235}U	4.46 kg
Enrichment ^{235}U	36%
Core height	600 mm
Experimental channel diameter	68 mm
Thermal neutron flux density:	
- in the central channel	$1.4 \cdot 10^{14}$ n/cm^2·s
- in two channels of the core	$1.1 \cdot 10^{14}$ n/cm^2·s
- in peripheral channels	$10^{12} – 10^{13}$ n/cm^2·s
Reactor life-time	14 days

Ampoule Gamma-Sources

Production of ampoule gamma-sources on the basis of reactor and cyclotron isotopes:

- for nondestructive defectoscopy
- for technical control devices (level meters, densimeter)
- for industrial analytical instrumentation
- for sterilizing medical materials and instruments

- **Cobalt-60**
- **Cadmium-109**
- **Cobalt -57**
- **Iridium -192**
- **Palladium-103**
- **Selenium-75**

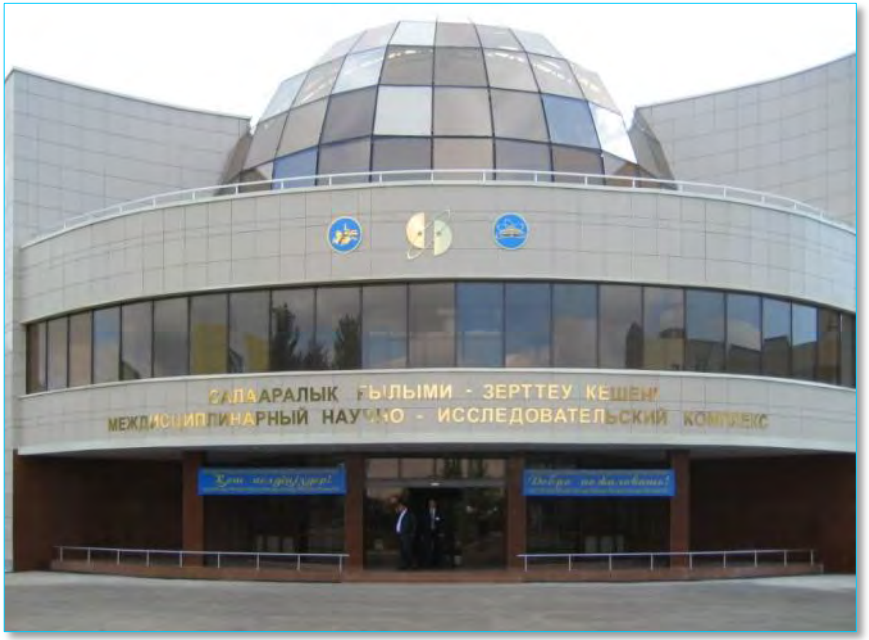
Film Coating and Thin Foil

Production of film coating and thin foil on the basis of ion-plasma technologies:

- for magnetron application of coatings from precious metals
- for application of protective coatings
- for synthesis of superconductive coatings based on niobium nitrite
- for production of high tensile and elastic fine-graded foils from beryllium-containing materials

Inter-disciplinary Research Complex at L.N. Gumilev ENU, Astana

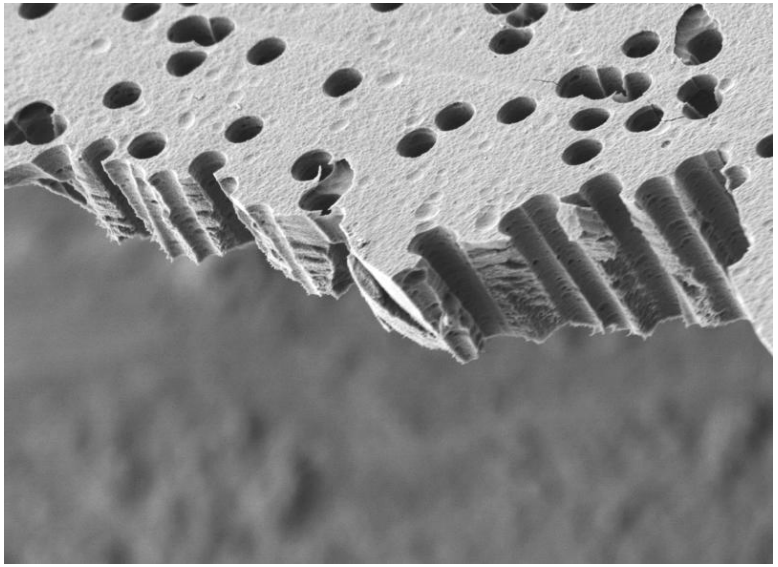
The inter-disciplinary research complex (IRC) based on **heavy ion accelerator DC-60** is the joint development of International inter-governmental organization "Joint Institute of Nuclear Research" (JINR, Dubna, RF) and Institute of Nuclear Physics NNC RK.

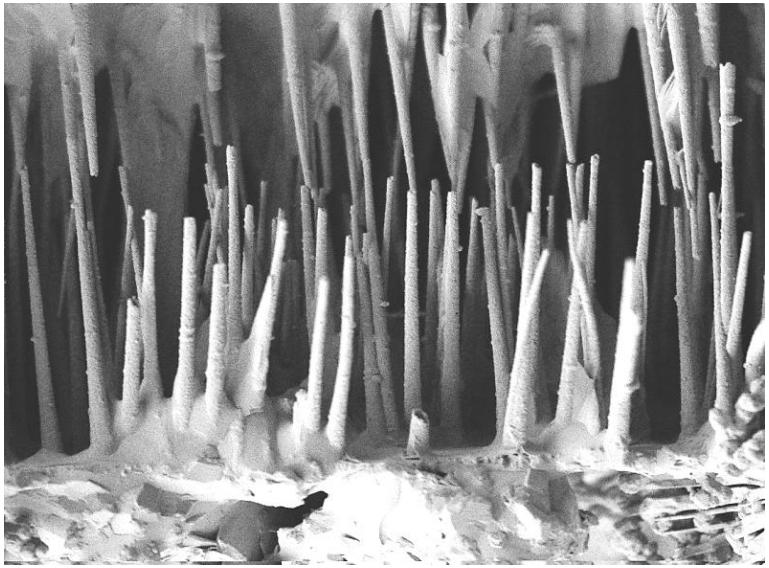


The complex is constructed in Astana and is located next to the main building of L.N. Gumilev ENU. Development of the complex involved the most advanced physical ideas and technical decisions. It made possible to construct one of the best accelerator in the world.

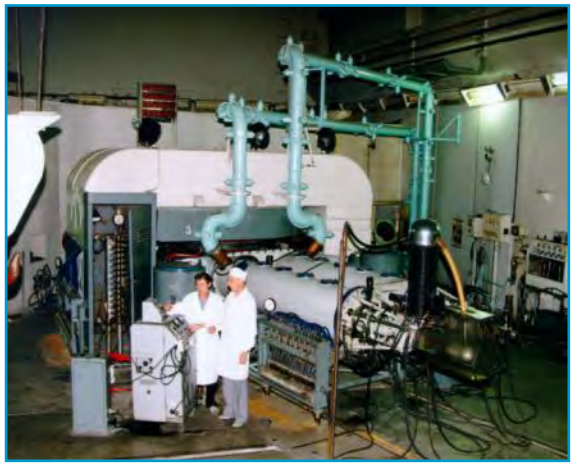
TRACK MEMBRANES – PROMISING MATERIAL OF NEW GENERATION

Track membranes are produced on DC – 60 cyclotron on the base of latex film. They can be used for water refining in pharmacy and for many different purposes





Accelerators and Test-Benches



Isochronous Cyclotron **U-150M**

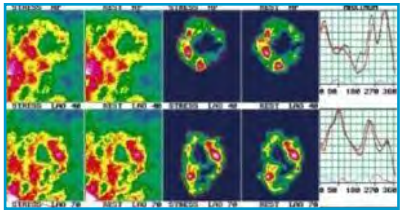
Small Size Cyclotron

Radiopharmaceuticals

Production of radiopharmaceuticals on the basis of reactor and cyclotron isotopes

Possessing an operating research reactor and cyclotron with controlled ion energy, Kazakhstan is capable of producing almost the entire range of radioisotopes for medicine.

Quality of preparations meets requirements of the European Pharmacopoeia and is controlled by means of the most-up-to-date analytical equipment.



Irradiation Sterilization

Irradiation sterilization of medical materials and instruments

Sealed packages are irradiated with high-power electron beam up to the dose of 25 kilo gray that provides for 100-percent sterilization.

High efficiency of sterilization process is ensured by the ELV-4 powerful electron accelerator, which is equipped with a conveyor.

Center of Nuclear Medicine and Biophysics in Almaty

The center is being created with the aim to develop and introduce in the RK health practices up-to-date diagnostics and treatment methods, recently developed at the interface of medical science, nuclear physics and information technologies.

Center's mission – provide conditions for creating and mastering new methods of diagnostics and treatment, perform scientific researches to develop new products of nuclear medicine and biophysics.

NEW FACILITIES:

- Radiopharmaceuticals production building
- Treatment-diagnostics complex
- Irradiation sterilization building

Total area of buildings: 16585 m^2
Staff: ~300 employees
Radio isotope production: ~30000 GBq/year
Radionuclide diagnostics in vivo: ~6800 procedures/year
Radioimmuno-diagnostics in vitro: ~24000 assay/year
Radionuclide therapy: ~1150 procedures/year
Irradiation sterilization: 137 mln. items/year

Polymeric Hydrogels

The technology of hydrogel radiation synthesis based on domestic raw was developed jointly with scientists from the named Al-Farabi KazNU.

In 2002, INP mastered a procedure of manufacturing polymeric hydrogels on the basis of ELV-4 electron accelerator with a capacity of 5 tons a year.

HYDROGEL APPLICATION

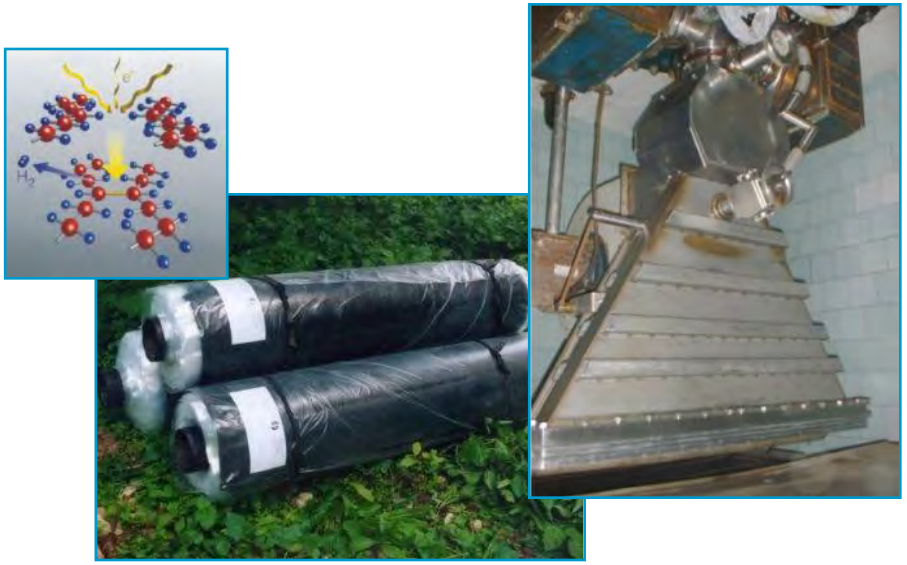
- coupling medium for ultrasound investigation
- hydrophilic material for medical unctures
- drainage
- bandage for burns treatment
- endoprosthesis replacement compound

Crovlen-2 Roofing Material

Technology of radiation crosslink at ELV-4 accelerator.

CROVLEN-2 roll roofing material is designed for roofing of buildings, serve as waterproof material in construction of underground structures, etc.

Produced of special sort of caoutchouc with polymeric additives using special radiation technologies providing its reliability, elasticity and resistance to atmospheric factors.



PARK OF NUCLEAR TECHNOLOGIES

Park is equipped by electron accelerator and production lines for manufacturing polyethylene foams and waterproof roofing material. Radiation processing of materials and products by an industrial ELV-4 electron accelerator is determined to improve the properties of material. Currently the electron accelerator is used as irradiation facility for the crosslinking of polymers, sterilization of medical products and curing of rubber.

CONCLUSION

The development of nuclear technologies is really impotent for Kazakhstan but it is far to be satisfied by the level of their development. The goods and services produced on the basis of nuclear technologies application are high demanded and our internal market is far to be sated in particular as to be related to medical service.

There are also some direction in radiation technologies which can be of great use for our country with its dry climate and power ecology – application for agriculture. Now we consider the possible aspects of investigation of this problem.

Future prospects of nuclear power production development in our country will give new impulse to our work in this direction and we believe that the sphere of nuclear technologies application will grow and the level will be improoved

Thank you for your attention!