ROLE OF NUCLEAR AND RADIATION TECHNOLOGIES IN OIL, GAS AND COAL MINING, DISTRIBUTION AND POWER SECTOR APPLICATIONS

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RECENT DEVELOPMENT AND APPLICATIONS OF NUCLEAR TECHNOLOGIES
Hotel Żubrówka ; Białowieża
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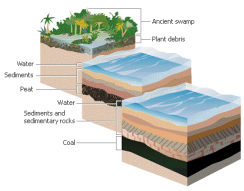
Applications

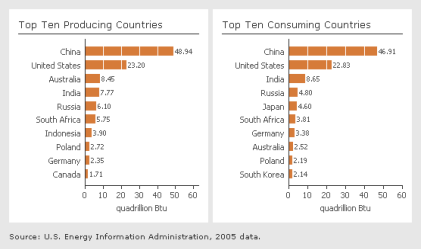
- Coal
- Oil
- Rafinieries
- Power industry

Coal mining

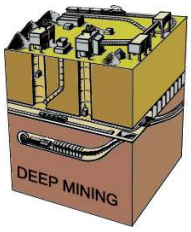
- Deep hard coal mines
- Open cast lignite mines

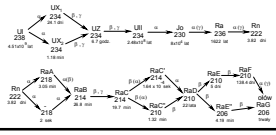


Coal Production and Consumption



Deep mining





Mining radiometer RGR-40

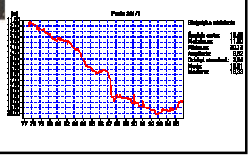
The radiometer measures alpha potential energy concentration of radon daughters and concantration of RaA (Po-218), RaB (Pb-214), and RaC+RaC' (Bi-214+Po-214).

Online Coal ash monitor

- *The gamma ray sources Am-241and Cs-137 are located under the conveyor belt and the detector is located above the b e l t .*

Lignite exploatation

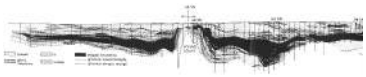
Bełchatów – water level 15 km from center

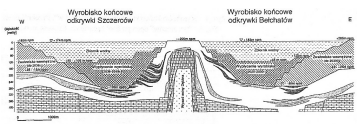


Water dranige

Mine	Coal	Soil cover	Water pumped	Ratio water/coal
	[mln Mg]	[mln m^3]	[mln m^3]	[m^3/Mg]
Adamów	159,4	1066,9	2595,2	16,28
Bełchatów	684,2	2928,1	599,2	8,76
Konin	493,6	2544,7	3963,7	8,03
Turów	792,8	1723,0	1016,3	1,28
Total	2129,8	8262,7	13574,4	6,37

Salt deposit





Environmental isotopes measurements

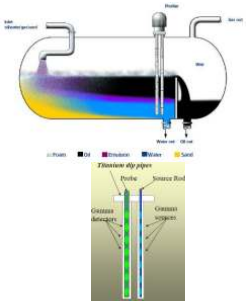
- ^{3}H to estiamte parameters of infiltration
- ^{222}Rn to estiamte parameters of ascenzion

- $\delta^{34}S$ i $\delta^{18}O$ in SO_4^{2-} to estiamte parameters of ash elution
- $\delta^{18}O$ i δD in H_2O molecule to evaluate water source

Oil fields

- Giant Ghawar Field Producing Half of Saudi Arabia's Oil Export (~ 5M BPD)- 30-50% of Production is Water
- Oil-Water-Gas flow meter- *Am-241 with emissions at 13.9, 17.8, 21.5, 26.3, and 59.5 keV*- Ba-133 source (30 and 360 keV)- Combination of Am-241 and Cs-137 sources (60 and 660 keV)

Water – oil separator



Oil pipes

X-ray inspection of pipeline welds

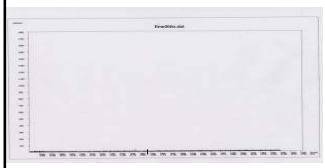
Leakages testing

- Gaseous methyl bromide labeled with Br-82 exhibits the best properties as radioactive tracer for the leakproof control. This compound is prepared from potassium bromide irradiated with thermal neutrons in a nuclear reactor. The transformation of the solid potassium bromide to gaseous methyl bromide is carried in a mobile chemical reactor.

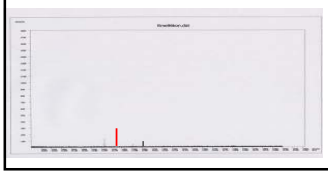
CONTROL OF PIPELINES WITH CLEANING CHAMBERS

- In the method gaseous methyl bromide (or potassium bromide in case of water) labeled with bromine-82 is introduced to the medium flowing in the pipeline directly from the generator or from special containers with the aid of compressed air or nitrogen.
- The leak (if present) is detected by means of a special gamma-ray detector (placed in a pressure casing) moving together with the medium.
- The detector is introduced to the pipeline at a preset time after the radioactive tracer has passed. It continuously records the natural background in the pipeline as well as peaks of Br-82 in the leak (if present).
- The activity of Br-82 in the leak necessary for distinct registration amounts to 1-10 μCi (37-370 KBq).
- The obtained record called „general localization of the leak" provides information as to the location of the leak with an accuracy of several to several tens meters depending on the distribution frequency of distance markers (Co-60 sources) placed on the outer walls of the pipeline.
- Accurate location of the leak is obtained by carrying out radiometric measurements of the ground below or the space above the pipeline in the zone selected on the basis of the „general localization".
- The minimum detectable leak is 500 cm^3/ h. Using follow up detectors it is possible to control pipelines with diameters of 200 to 600 mm.

A - background of pipeline and on figure B -the some place with leakage at 13488 meters from first distance marker.



A

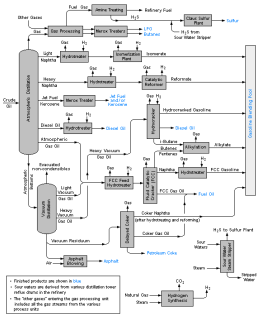


B

The control of pipelines with cleaning chambers is carried out during their normal exploitation.

Refineries

Schematic flow diagram of a typical oil refinery

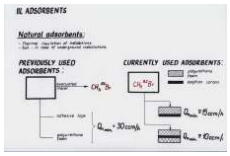


Leakages testing

- **The general principle of the radioisotope method consists in introducing to the controlled object a radioisotope tracer, which after having mixed with the control or working medium travels towards the leak, where it is adsorbed on natural (thermal insulation) or synthetic sorbents (special materials applied before the control).**
- **Radiometric measurement of the adsorbent permits to precisely locate the leak or to exclude its presence.**

LEAKPROOF CONTROL OF TECHNOLOGICAL INSTALLATIONS

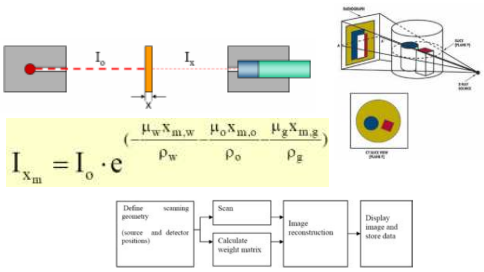
- **After having been labeled the controlled object or a complex of objects is filled with compressed dry air or nitrogen up to the test pressure.**
- About 20 hours after the test pressure has been reached radiometric measurements are carried out.



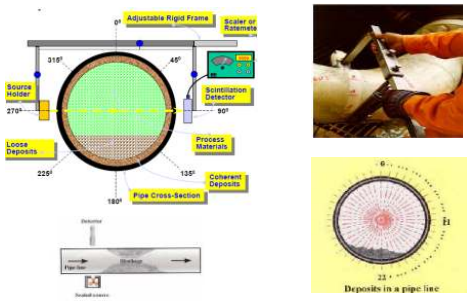
LEAKPROOF CONTROL OF TECHNOLOGICAL INSTALLATIONS

- The leakproof control of technological installations can be divided into three groups depending on the way in which the radioisotope tracer of the leak is adsorbed. The way of dispensing the tracer (gaseous methyl bromide) is the same in all the groups. The tracer is fed to the object from the generator. It is recommended that the specific activity of the medium be of the order of 1 mCi (37 MBq) per 1 cubic meter. This permits to attain a sensitivity of leak detection of about 30 cm^3 / hour.

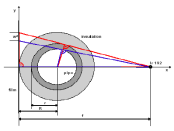
Principles of radiography and tomography

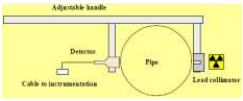


Deposites in pipes

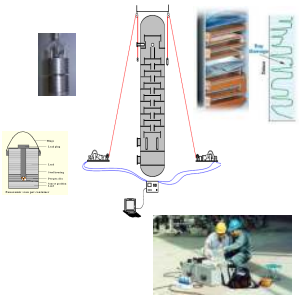


Tangential radiograghy for corrosion and deposits measurements

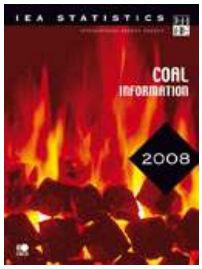




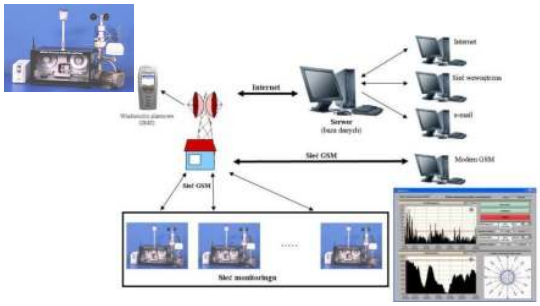
Column gamma scanning



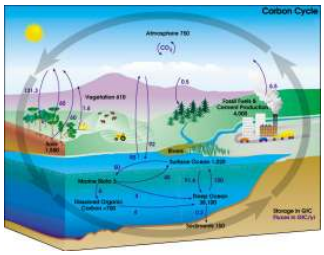
Air pollution monitoring and control



Wireless system for air dust concentration monitoring

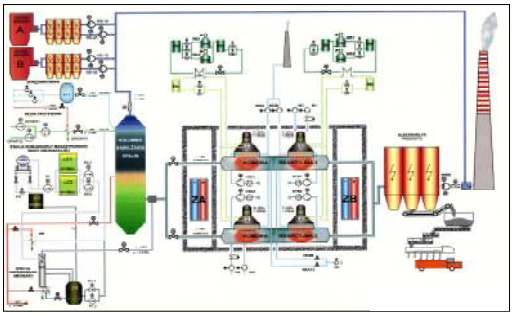


Carbon stable isotopes as markers for CO_2 sources and sinks



EPS Pomorzany - general view

Plant layout



Conclusions

- Stable and environmental isotopes are applied for monitoring and control of mines and oil fields exploatation.
- Nucleonic control systems and radiotracer methods are important tools for optimal and safe operation of the mines, oil fields and pipe lines.
- NCS and stable isotopes methods are used for air pollutants monitoring.
- Radiation technologies are used for pollutants emission control.