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ON GOING ACTIVITIES ON NOBLE GAS MEASUREMENTS AT ENEA (ITALY)

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INTRODUCTION

The noble gas monitoring activities have been recently recognized at **Italian National Agency for New Technologies, Energy and Sustainable Economic Development** (**ENEA**) as a strategic task for an early acquisition of data about environmental and anthropic activities. Some Italian regional and national projects have addressed this issue and the related technologies.

The measurement of noble gases started this year at ENEA within the **CTBT** and **NDC** related activities. A preliminary sampling device was planned and set up within the framework of institutional agreements for the implementation of a laboratory for the measurement of noble gases for **environmental analysis** and for monitoring studies related to the Italian national plan on the **near surface repository** for radioactive wastes. This equipment, that has the **sampling unit** separated from the **extraction** and the **analysis** facility, may have some possible applications also in the measurements of atmospheric noble gases for an On Site Inspection, as the sampling unit can be easily settle down in the framework of on-field activities, while the extraction and analysis processes may be performed in the on-site laboratory.

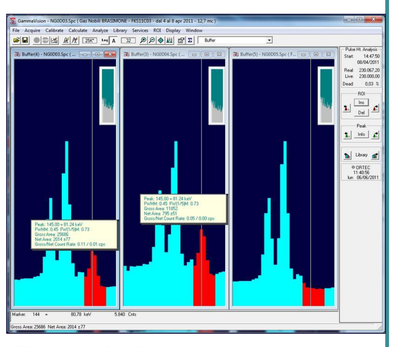


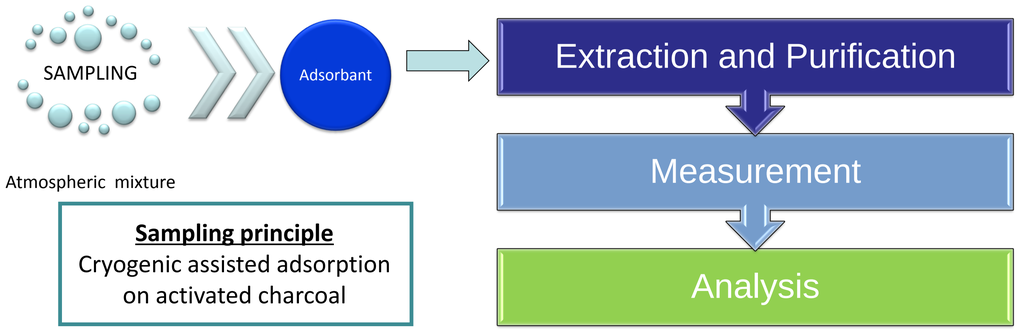
Figure 1- Poster presented at WOSMIP 2011

Some preliminary measurements were made on April 2011, following the Fukushima incident. The charcoal that adsorbed the gaseous mixture was directly measured with HPGe (without any extraction stage) and the spectra analysis showed the peak of Xe133 (Fig. 1). It was evident that the Xe peak could be related to the Fukushima incident and that it would be better to clean the sampled air from the other gases that interfere with the Xe-133 line, particularly in the case of low activity concentrations.

Some improvements in the sampling procedure and in the extraction process were made and here reported.

This approach can be also useful for **On Site inspection scenarios** in which the sampling strategy was not strongly supported by hypothesis or other relevant signatures. In this case the easily portable sampling unit can be used to collect a greater number of samples, to be screened out subsequently, or to make opportunistic sampling not previously planned.

THE TWO STAGES APPROACH



Sampling principle
Cryogenic assisted adsorption on activated charcoal

The splitting of sampling and measurement devices may be effective for very extensive sampling campaigns, as required in monitoring programs, to assess the performance of a radioactive waste repository and could be easier to deploy in critical environmental conditions.

DESCRIPTION OF THE SYSTEM

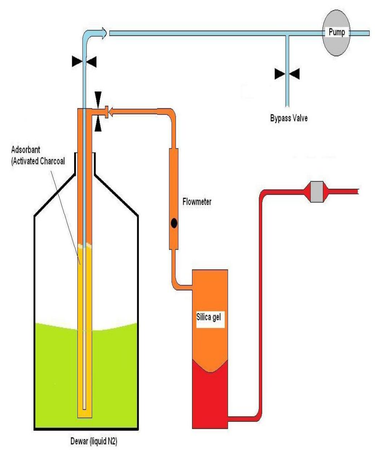
Sampling device

Sampling process: Adsorption of gases on liquid nitrogen cooled activated charcoal.

Sampling device: The air, sampled by a vacuum pump, was partially separated from aerosol (filter GF/F) and water (silica gel), then fluxed through an adsorbant cartridge containing, in the lower part, activated charcoal particle (0.3 – 0.5 mm) cooled to a cryogenic temperature by liquid nitrogen. At least 80m^3 of air were sampled in a week (flux 500 l/h).

The sampling equipment was constructed at ENEA along the lines of the BfS system [1].

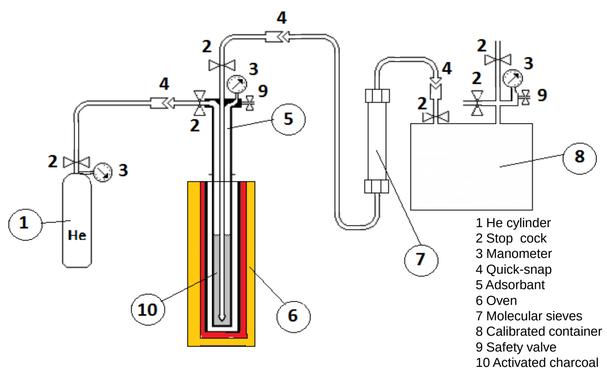
Sampling scheme



Sampling set up

Adsorbant cartridge inner part

Desorption device



Desorption scheme

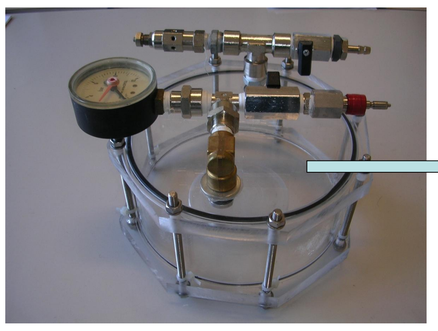
Desorption device (front and back view) [2]

- ❑ At the end of sampling cycle, the adsorbant cartridge was warm up till room temperature and the condensation water formed inside to the column was completely removed.
- ❑ The desorption process was carried out at T= 280 °C, with a slow ramp. The heating system consists of 4 electrical rings, settled around the cartridge vessel and is controlled by digital electronics.
- ❑ Transfer of the sample to the calibrated vessel (8) using inert gas carrier (1) at 1.5 bar of pressure and passing through sieves cartridge (7) for removing effectively the CO_2 and H_20.

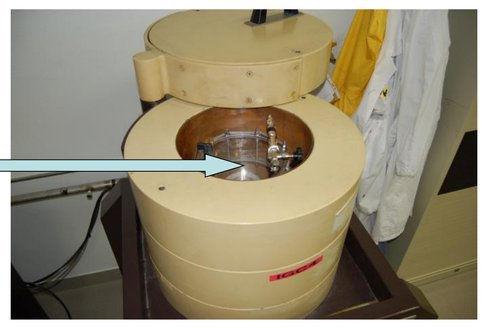
Detection stage

The acquisition of the spectrum is on the way and it will be accomplished according to the following procedures:

- ❑ The plexiglass calibrated container containing the sample will be placed into the well of the germanium detector (HPGe) on the top of the Ge crystal for measurements.
- ❑ **Detector**: low background HPGe detector (ORTEC GMX-60230), N-type, Al endcap (Be window), 60% relative efficiency, cooled by liquid nitrogen, analogic electronic system.
- ❑ The absolute efficiency is not yet evaluated because we did not have any reference Xe-133 source (the efficiency was extrapolated by using Radon).



Cylindrical plexiglass container equipped by two valves for the vacuum pumping and the transfer of the gaseous sample



Positioning of the box in the well of the germanium detectors

The spectra analysis of the extracted gaseous mixture that results from the above described system will permit to assess the efficiency of the extraction process.
Further improvements are envisioned and will be implemented to fix the important parameters in order to improve the extraction yield and the sensitivity of the entire process and to choice the right equilibrium between the duration of the sampling and the decay time of Xe isotopes.

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(2) Thanks are due to Mr Fabiano Serra (ENEA UTIS-PNIP, Brasimone Research Centre) for the construction of the sampling equipment.