SLUDGE SAMPLING SYSTEM IN SILOS STATUS AFTER THE FIRST ACTIVE CAMPAIGN (LA HAGUE - FRANCE)

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ABSTRACT

The liquid effluent treatment station of the UP2 spent fuel reprocessing plant generated chemical coprecipitation sludge up to 1989. The sludge is stored temporarily in silos adjoining the facility.

As part of the studies on the retrieval and packaging of the sludge entrusted to SGN by COGEMA, a program of sampling the active sludge has been initiated. It is designed to improve the chemical and radiochemical knowledge of the sludge, and also to shed light on any ageing processes.

A nuclearized sampling system has been developed in order to take samples at different altitudes.

ORIGIN OF SLUDGE STORED IN SILOS

The stored sludge corresponds to the treatment of aqueous effluents produced at La Hague essentially resulting from the reprocessing of fuel elements (Fig. 1).

The chemical composition of the sludge results from:

- the chemical coprecipitation reagents used in the two lines of the STE2 effluent treatment station,
- the ions present in the effluents and likely to precipitate during coprecipitation treatment.

SLUDGE CHARACTERISTICS

Because of additional settling of the sludge in the silos, the supernatants were regularly withdrawn. Since the effluents and treatments varied over the years, the different sludges are assumed to have accumulated in the form of layers of variable composition and consistency. Settlement was also confirmed by regular level measurements.

The sludge height in the silos is about is about 8 m.

Simulations on inactive sludge showed that the sludge was thixotropic and could occur in fluid, viscous or plastic form.

Sludge activity ranges in the silos as follows:

- $\beta\gamma$ 30 to 600 Ci/m^3
- α 3 to 30 Ci/m^3

PURPOSE OF THE SAMPLINGS

The sampling operations have several objectives.

To validate the inventory compiled from the operating logs, i.e. by samplings taken at different altitudes, to locate the layers and identify the chemical and radiochemical compositions, to detect any sludge ageing.

To determine the retrieval systems and conditions, i.e. to analyze the rheological behavior of the sludges in order to identify the ideal agitation and pumping system, to predict the pressure drops during transfer, and the requisite dilution factors.

To test different packaging and treatment processes, i.e. first to check the compatibility of the sludge with bituminization (reactivity and characteristics of bituminized sludge).

This requires the following:

- taking an intact sample,
- sampling along the entire height of the silo,
- withdrawing a minimum volume of 250 cc.

DESIGN OF THE SAMPLING MACHINE

Taking an "intact" sample in a loose terrain is extremely difficult, because the medium is easily disturbed by the coring operation. An inventory and an assessment of the different sampling techniques used in geotechnical drilling led us to use an Osterberg type corer as the sampling probe. This instrument is based on the principle of sampling by thin-wall core barrel and stationary piston.

After some vane penetrometer tests, it was decided to discard gravity penetration of the corer by wireline in favor of a positive thrust system of the drill stem type. To avoid the loss of the sample due to a lack of cohesion or disintegration of the sludge during pullout in the very dilute phases (supernatants), a diaphragm retainer was added.

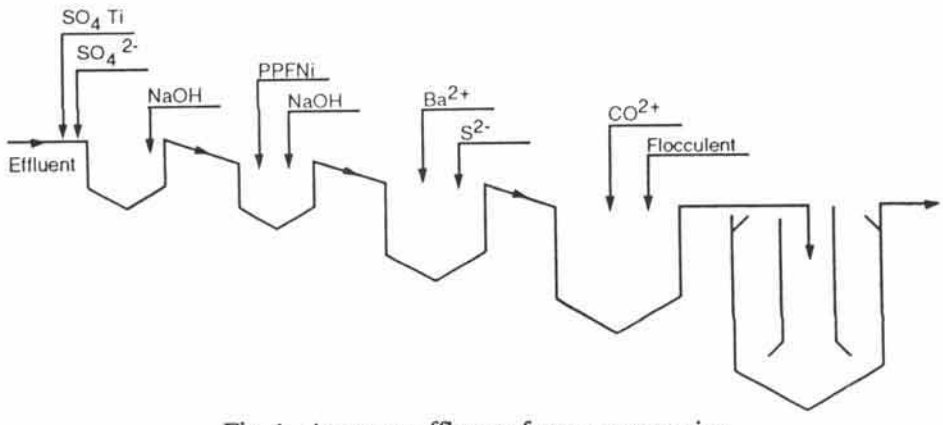

Fig. 1. Aqueous effluents from reprocessing.

This arrangement thus prevents the pollution of the sample during the relatively long pullout times for samplings at the silo bottom

The main operating steps of the sampling probe are (Fig. 2):

- phase 1: penetration of the corer to a predetermined altitude in the sludge by adding drill stem elements,
- phase 2: pneumatic pushdown of the core barrel around the stationary piston, closure of the diaphragm retainer below the sample,
- phase 3: pullout of the corer by withdrawing stem elements and placing it on the jug,
- phase 4: opening of the diaphragm and drainage of the sample into the jug by lowering.the piston

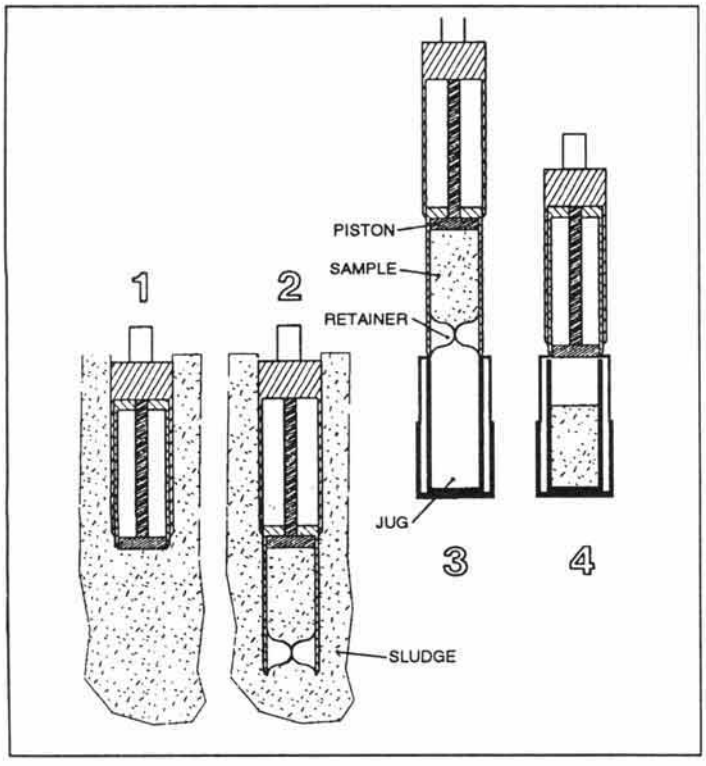

Fig. 2. Operating steps of sampling probe.

EQUIPMENT NUCLEARIZATION

The principles of nuclearization of the machine are based on the containment of all the sampling operations in two surimposed boxes (Fig. 3):

- a shielded box where the following are performed:
  - pullout of the corer with its sample towards the top,
  - drainage of the sample in the jug,
  - closure of the jug and its rinsing,
  - docking of the cask for transfer of the jug to the laboratories,
  - decontamination of the drill stem and of the control wireline during pullout,
- a glovebox where the following take place:
  - stem making / breaking operations,
  - stem racking,

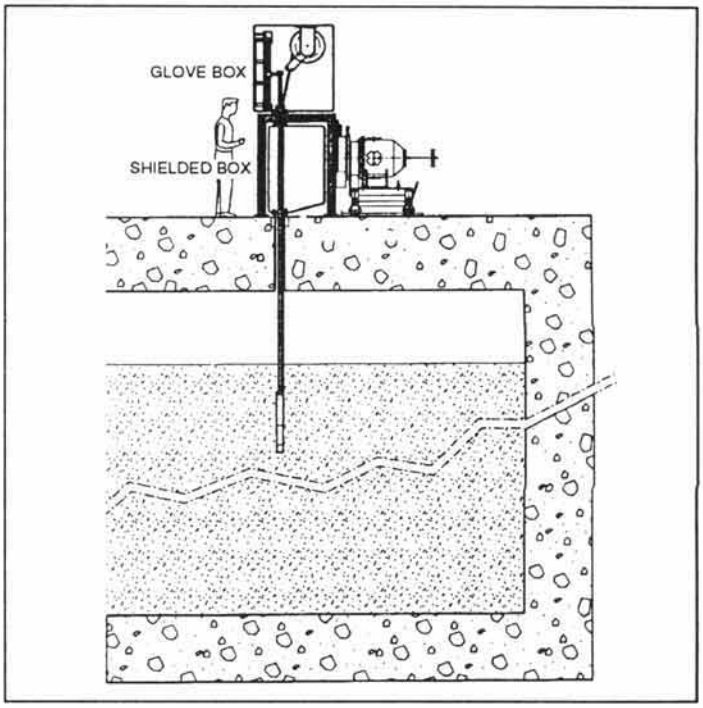

Fig. 3a. Sampling operations.

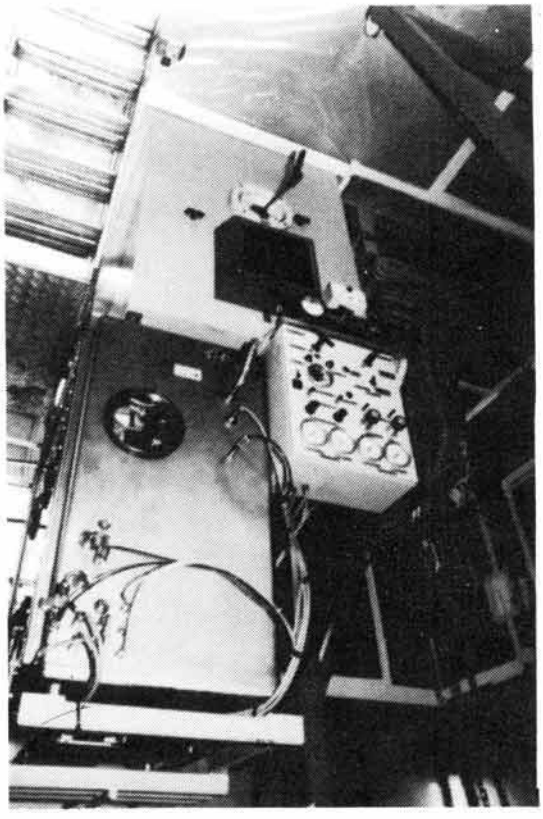

Fig. 3b. Sampling and glove boxes.

  - maintenance of pre-decontaminated or non-irradiating equipment.

Special care was also paid to the surface condition of the parts in contact with the sludge, particularly the stem joints. The length and weight of the stem elements were determined by the fact that they had to be compatible with manual handling using gloves.

The sampling unit is installed in a ventilated air lock located on the slab covering the silo to be sampled. This air lock also makes it possible to core the 1 m thick concrete slab and to anchor the connecting sleeve between the sampling box and the interior of the silo.

The boxes are internally ventilated by the silo ventilation system.

CAMPAIGN ON THE FIRST SILO

The first sampling campaign took place in August 1992 and concerned a silo containing about 2000 m^3 of sludge. The sampling depth increment selected (0.5 m) led to the taking of 18 representative samples along the entire sludge height. A series of additional samples were taken at the end of the campaign to make up the test batches.

All the samples were taken over a 15-day period, and radiological monitoring of the operators was satisfactory.

RESULTS

The analyses were carried out in the laboratories of COGEMA and the CEA.

Examination of the analytical results reveals a similarity with the inventory for the chemical compositions. However, the analyses of the soluble salts revealed a nitrate deficit, that can be explained by the withdrawal of the supernatants after transfer.

The sampling altitudes were also confirmed by the calculation of the decrease in activities.

While the rheology tests have not yet been conducted (prior activation of a cell), micro-calorimetry tests on samples of bituminized active sludge already indicate that their reactivity is zero in the temperature range considered.

This program helped to identify the spectrum of alpha radionuclides.

At last leach tests on sludge and soluble activity measurements have indicated good radionuclide containment, which will be very advantageous during retreval and packaging operations.

CONCLUSION

This first sampling campaign enabled us to validate the technical alternatives selected for the sampling equipment from the performance and radiation protection standpoints.

The first analytical results confirmed our methodology, and should soon help us to determine :

- the sludge retrieval and transfer systems,
- the feasibility of the treatment and packaging processes, the volume of packaged wastes.