

# RADIOACTIVE CONTAMINATION DUE TO NUCLEAR MEDICINE EXAMINATIONS IN LIQUID AND GASEOUS MATRICES

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Measurements carried out since 1980 on the radioactivity of liquid wastes produced by the city of Bologna and due to the activity of Nuclear Medicine Departements.

Radioactivity was measured in the fumes produced by sewage sludge inceneration too.

## INTRODUCTION

The "Servizio di Fisica Sanitaria" of the University of Bologna checks radioactive pollution and its environmental impact due to scientific research and industrial or medical activity.

Because of the past experience, we can conclude that the most important radioactive impact is due to the Nuclear Medicine Departements (Malpighi and Maggiore Hospitals).

Liquid wastes produced by the city of Bologna and surrounding areas are collected by a sewage system, leading to a depuration plant; the capacity of the sewage system is about 250,000 mc per day.

The samples (about 200 in June 1991) were taken at the entrance and exit of the city depurator. Radioactivity was measured in muds, ashes and fumes produced by treatment of the depuration.

Samples were gathered "in continuo" from the liquid at entrance by means of a fractions collector during all the week night and day.

The depuration cycle produces about 10,000 tons muds. The muds combustion yields 750 tons ashes and 10 million mc fumes per year.

The radioactivity in the fumes was collected on cellulose filters and active coal caps by means of a suction pump during 30 minutes ( 3 mc per min.).

Before letting into atmosphere, fumes were washed with depurated water that was tested too.

We did not regularly check the activity of beta-emitter radionuclides, since they are used only for analysis "in vitro" and liquid waste is not released into the sewage system, nevertheless some untreated samples (1 ml) were tested and no radioactivity was found.

## MATERIALS AND METHODS

For beta-emitters radionuclides, to 1 ml sample 12 ml scintillation liquid HT Ready Solv. (Beckman) were added, and then the mixture was tested by a Beta-counter Beckman LS-100 during 8 hours

For gamma ray spectrometry we gathered samples of the liquids at entrance and exit of the depurator, of the ashes, of the fumes, and of the fumes washing water.

1 litre of untreated sample was counted in "Marinelli" beaker (anular geometry) by a high-purity Germanium coaxial detector ( 2 KeV resolution at 1330 KeV, relative efficiency 30%) or a 3"x3" NaI(Tl) crystal ( 6,5% resolution at 662 KeV). Minimum detectable activity was about 0,5 Bq/litre.

The cellulose filters and active coal caps were tested in the same counting-chaine, but in an other geometry.

The counting-chaine calibration was performed by a calibrated source QCY-44 (Amersham) in aqueous solution.

Quantitative valuations were carried out for Tc-99m, I-131, I-125, Tl-201, Ga-67, Xe-133, Cr-51, Co-57 with a counting time of 2000-5000 sec.

## RESULTS

The results are explained in the following figures and tables.

Fig.1 Illustrates input capacity of depurator during a day , and the quantity of Tc-99m measured in an hour.

Fig.2 Refers the weekly course of Tc-99m in entrance at the depurator.

In tab.1 are compared the activities administered to the patients in a week, with the activities in entrance at the depurator, in fumes, in ashes and in the fumes washing water.

Tab.1

	Tc-99m	I-131	I-125	Tl-201	Ga-67	Xe-133	Cr-51	Co-57
A.A.	85459	5595	567	3145	1813	2400	.6	.074.
L.EN	22441	1375	-	Traks	258	13	Traks	Traks
FUMES	-	.0025	-	-	.035	-	-	-
ASCH.	7.2	-	-	2.8	7	Traks	-	Traks
WAW	17	28	-	-	12	-	-	-

A.A : Activity administered to the patients at the Nuclear Medicine Departements (Malpighi and Maggiore Hospitals).

L.EN : Activity measured at the entrance of the depurator.

FUMES : Activity measured in the gases leaving the burning plant.

ASCH. : Activity measured in the ashes produced by combustion of muds.

WAW. : Activity measured in the fumes washing water.

Activity is measured in Bq X 10<sup>6</sup>.

Fig.1 ----- Capacity measured in  $\text{m}^3/\text{h} (\times 10^3)$   
 +---+ Activity measured in Bq/l

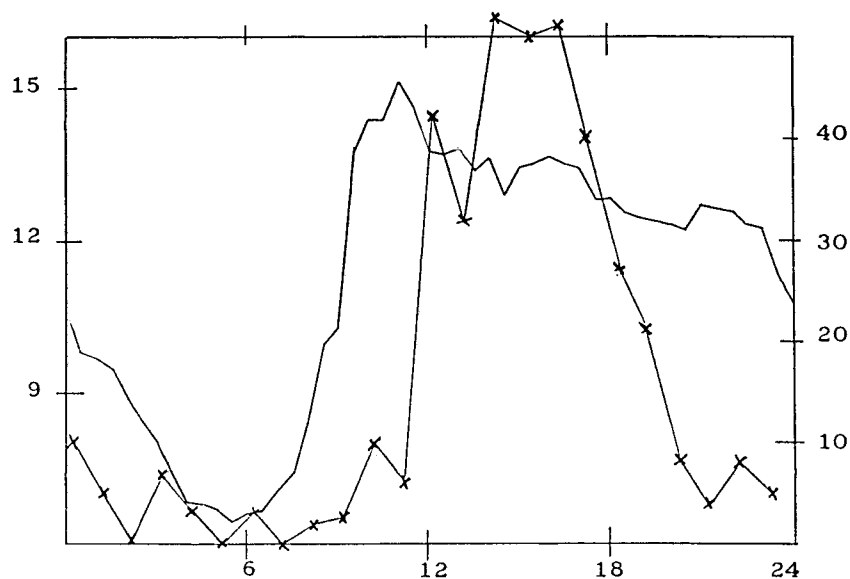
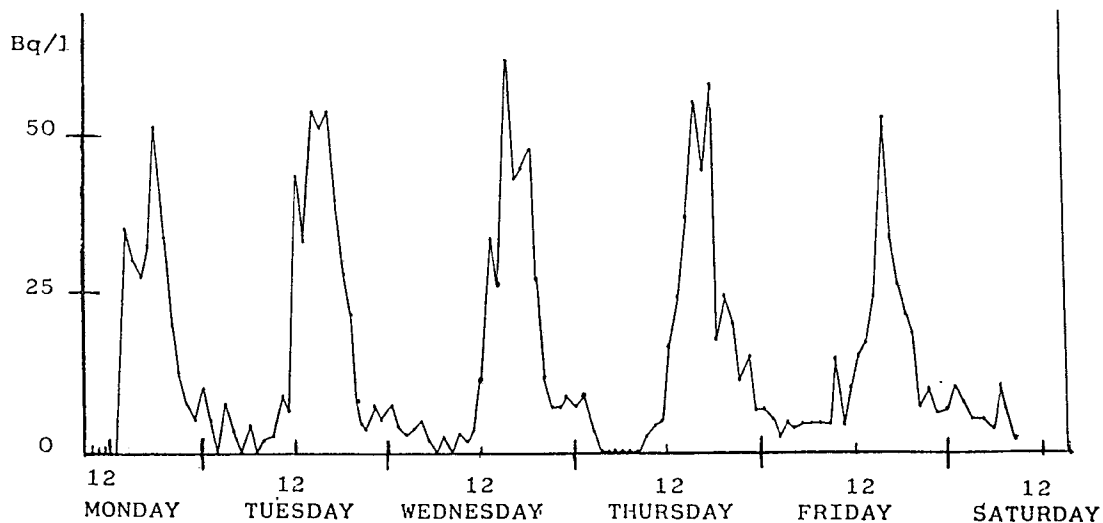


Fig.2



## CONCLUSIONS

1) If H-3 and C-14 are present in the Bologna sewage system, they are not measurable by our equipment (in any case less than 1Bq/ml)

2) The radioactive impact due to the Nuclear Medicine Departments is not particularly important (till now!).

3) The transit through the sewage system and the depuration process strongly pull down the radioactivity of used nuclides, because of their low average-time.

4) The radioactivity in the gases leaving the depurator is completely negligible.

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