



Ventilation, radon and thoron: results from a Dutch survey

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Introduction

Radon concentrations in Dutch dwellings are low compared to those in many other countries. Surprisingly, results of a recent survey showed a very sharp drop in concentrations measured in newly constructed dwellings. We discuss the background of the survey and explain its unexpected results.

VERA: VEntilation and RAdon

Since the 1980's, three nationwide radon surveys have been conducted in the Netherlands. Results of the first two surveys:

- indoor radon concentrations in Dutch houses are low compared to those in many other countries,
- concentrations increased with year of construction of the dwelling. Assumption: consequence of improved insulation and consequently reduced ventilation and increased use of concrete.

In 2006: survey conducted by the National Institute for Public Health and the Environment (RIVM) in Dutch dwellings to

- monitor the development of indoor radon
- study the effect of ventilation

Materials and Methods

"Intensive survey"

Year long measurements in 300 dwellings (constructed 1994-2003), 4 rooms per house

- radon measurements (passive detectors)
- external radiation measurements (TLD's)
- determination of air flow between rooms (tracer gas method)

In addition: questionnaire, determination of capacity of mechanical ventilation (required in new Dutch houses)

"Mail order survey"

Single radon detector in 800 dwellings

Results

Ventilation

In many cases, individual airflows could not be determined from tracer gas experiments, but in a subset of dwellings where this was possible, a negative correlation between ventilation and radon concentration was found.

Radon

Table 1: Radon measurements in Dutch dwellings constructed between 1994 and 2003

	Average (Bq/m ³)	Median (Bq/m ³)	# rooms
Living room	13.5	11.8	1011
Bedroom	13.0	10.8	296
Hall	15.6	12.5	292
Entrance hall	12.9	9.9	47
Crawl space	45.5	28.4	149

External radiation

Average annual dose: 0.35 mSv/year.

Ventilation and radon

Estimates for airflows give information about sources of radon. In the Netherlands:

- 67% from rooms included in survey (building materials)
- 23% from outdoors and rooms not included in survey
- 10% from crawl space – includes soil contribution.

Discussion

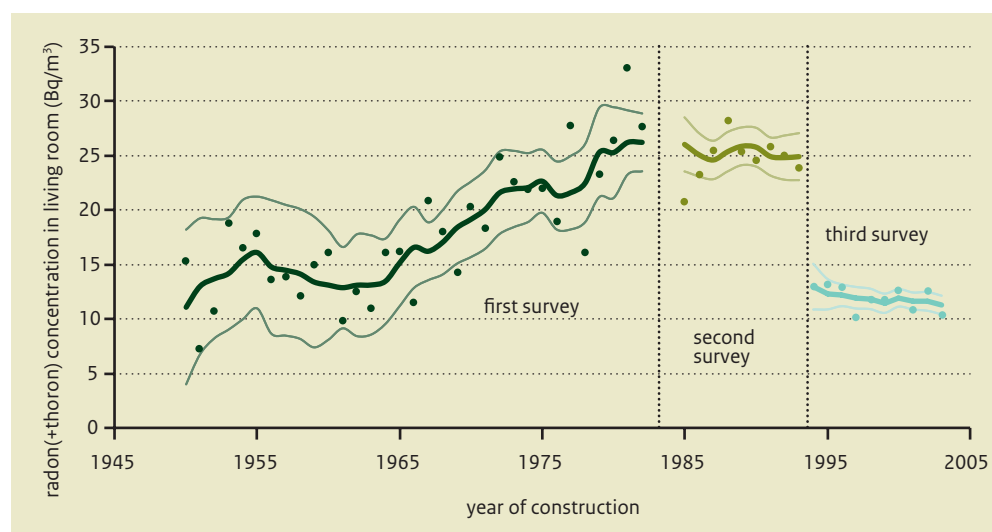


Figure 1: Comparison of results from three surveys: indoor radon concentrations.

Surprisingly, figure 1 shows a sharp drop in measured radon concentration in houses built after 1994. This drop cannot be explained by a change in building procedures.

Conclusion: radon detectors used in earlier surveys measured not only radon, but also thoron, and thoron is a bigger contributor to indoor dose than previously assumed. Radon concentrations are lower than previously assumed.

Pilot measurements: thoron progeny contribute significantly to dose in some Dutch houses – in some cases more than 1 mSv/year. Source of indoor thoron are building materials, specifically finishing materials.

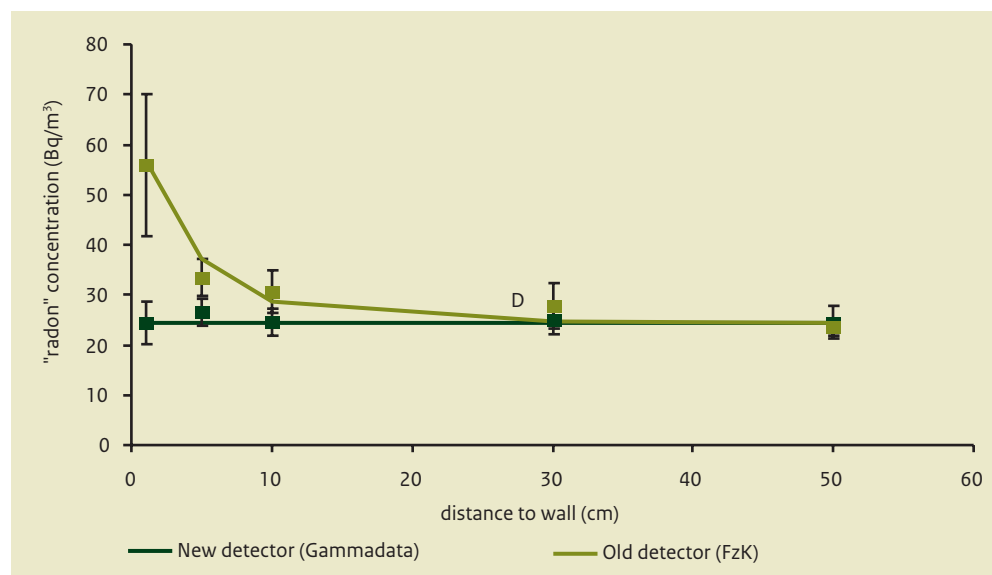


Figure 2: Due to its short half life, thoron concentrations decrease sharply with distance to a source, e.g. a wall, whereas radon concentrations are (almost) constant. The old detectors show "radon"-concentrations that drop off very quickly.

2012: start of new survey to determine

- radon concentrations (now unknown in older houses)
- thoron progeny concentrations