

## APPLYING THE LIQUID SCINTILLATION SPECTROMETRIC METHOD FOR MONITORING TRITIUM IN GROUNDWATER

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**ABSTRACT.** We monitored tritium in groundwater over the past 7 yr around potentially polluted zones in Latvia, including the area surrounding a waste repository and an inactive nuclear reactor. In order to perform the tritium monitoring, we employed liquid scintillation spectrometry in optimized modes using the scintillation liquid OptiPhase HiSafe 3 (Perkin-Elmer, USA) and Packard Tri-Carb and Wallac liquid scintillation spectrometers. Samples were gathered 4 times a year from 19 wells at depths ranging between 2.5 and 9 m. The tritium content in certain wells varies widely, and there are recognizable seasonal changes. Thus, the maximum tritium concentration in the same well changes from year to year. The results obtained make it possible to estimate the changes and migration of tritium pollution, as well as to forecast future changes.

### INTRODUCTION

According to Latvian law, the level of tritium in drinking water must not exceed 100 Bq/L. Thus, it is important to monitor tritium in groundwater around potentially polluted zones such as those surrounding radioactive waste repositories and inactive nuclear research reactors (Gueleva et al. 2004; Vilgis et al. 1998). Tritium measurements have been carried out since 1997 in groundwater in the vicinity of the inactive Salaspils nuclear research reactor and radioactive waste repository. We discuss the variation of tritium activities in these 2 sites in Salaspils based on our results over the past 7 yr.

### METHOD

#### Sampling

Samples were gathered from 31 wells that are located on the main groundwater streams. Of the 31 wells, 19 were located at or near the inactive Salaspils reactor, while 4 wells were in the radioactive waste basins in the waste repository and 8 more were near the repository. The depth of the wells was between 2.5 and 9 m. Water samples were gathered 4 times a year; in wells where higher levels of pollution were detected, samples were gathered every month.

#### Testing

For monitoring tritium, liquid scintillation spectrometry (similar to ISO 9698 [International Organization for Standardization 1989]) was used in optimized modes using the scintillation liquid OptiPhase HiSafe 3 (PerkinElmer, USA). This method was certified by the Latvian national accreditation bureau. Sample measurement was carried out with Packard Tri-Carb and Wallac liquid scintillation spectrometers. The measurement time did not exceed 12 hr; thus, the uncertainty was <2%.

### RESULTS

The tritium in the wells' groundwater varies in concentration, and seasonal changes are recognizable. The maximum concentration in each well changes from year to year. These results make it possible to estimate changes and migration of tritium pollution and to predict future changes.

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The concentration of tritium in 3 wells from 1997 to 2005 is shown in Figure 1. Two of the wells are located in the territory of the inactive Salaspils reactor (9V, 10V) and one is outside this territory (2B). The wells 9V and 10V are 9 m deep and in a limestone layer, and well 2B is 4.5 m deep.

The increase of <sup>3</sup>H concentration in the year 2003 samples (Figure 1) can be explained by the washing out of the previous tritium contamination due to meteorological conditions. We know that there are washed-out gypsum caverns in this territory.

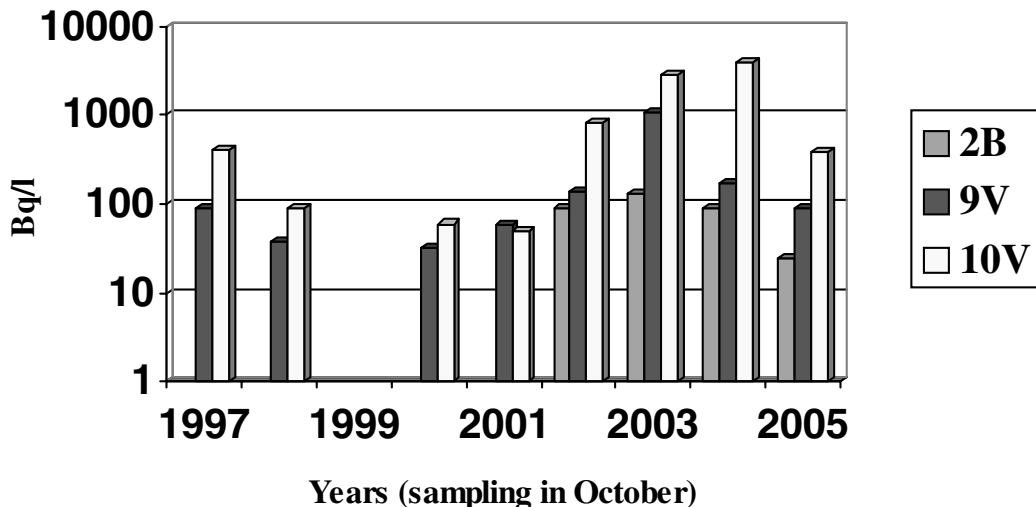


Figure 1 Tritium concentration in wells in the vicinity of the reactor

Figure 2 shows the <sup>3</sup>H concentrations in well 10V measured monthly during 2004. One can see the periodic nature of these changes.

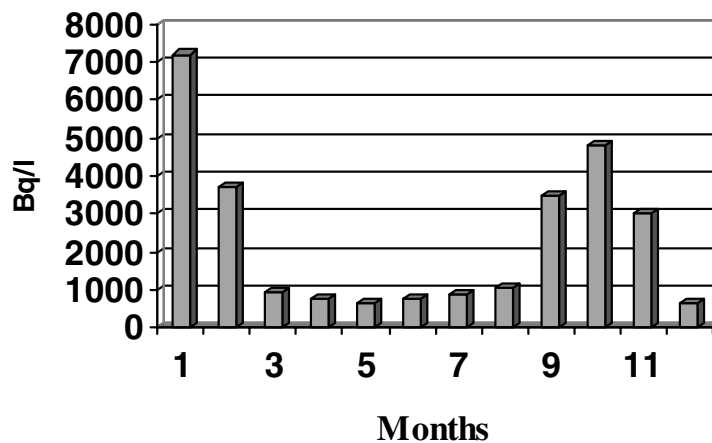


Figure 2 Tritium concentrations in well 10V (measured monthly in 2004)

From 2001 to 2005, <sup>3</sup>H concentrations were also measured in 12 wells located 150 m to 3 km from the reactor. Results show that the tritium concentration in the wells does not exceed 8–10 Bq/L. One well showed a considerably higher level (16–40 Bq/L) than the other wells.

$^3\text{H}$  concentration in the radioactive waste repository wells is shown in Figure 3. One can see that the  $^3\text{H}$  concentration does not exceed the maximum allowed level for drinking water. Only one well (B3) in the direct vicinity of the radioactive waste basin had a notably greater value.

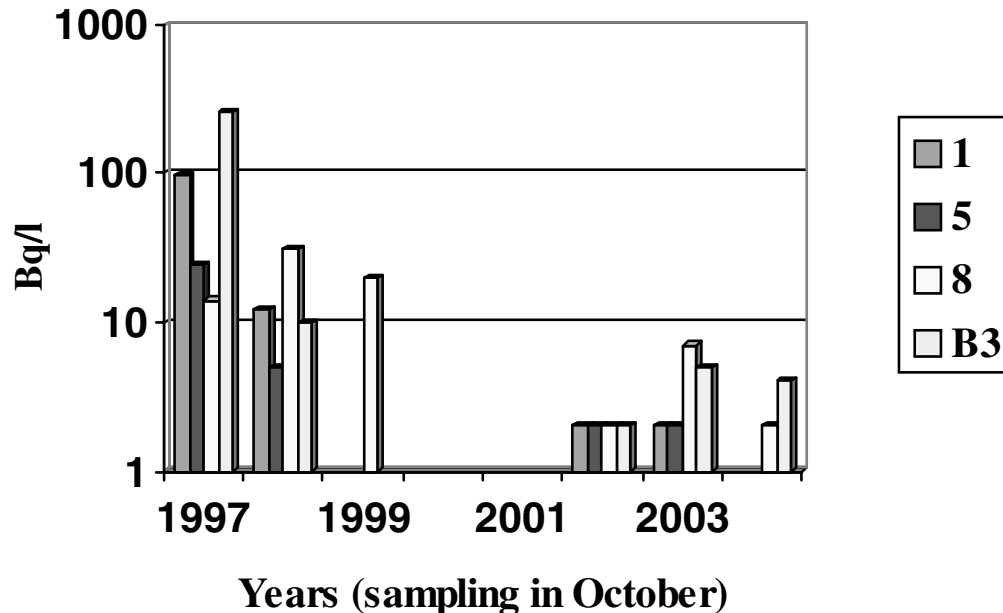


Figure 3 Tritium concentration in the wells of repository territory

## CONCLUSIONS

We monitored the tritium concentration level for the past 7 yr in wells in the vicinity of the inactive Salaspils reactor and its radioactive waste depository. Increased tritium concentration was detected in 3 wells in the reactor territory and in 1 well of the radioactive waste repository. Also, periodic changes of tritium concentration level were observed in some wells of the reactor territory.

Near the radioactive waste repository, an increased concentration of tritium was observed in 1 well in the direct vicinity of the waste basin. The tritium concentration in this well was more than 10 times lower than that of the 1997 data. The  $^3\text{H}$  concentration in wells in the rest of this territory was within 2–18 Bq/L during the last 5 yr, which is well under the Latvian legal limits for tritium in drinking water.

## REFERENCES

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