



Rn-222 IN WATER WITH HIDEX 300 SL AND TRIATHLER

1. Introduction

Hidex 300 SL and Triathler with α/β separation option are ideal tools for measurement of Rn-222 in water. There are two main methods: 1) **direct method** where water is simply mixed with water-accepting cocktail and 2) **extraction method** where Rn-222 is extracted from water to water-immiscible (lipophilic) cocktail. Direct method is fast whereas extraction method offers great sensitivity. This application note provides an introduction how to use Hidex 300 SL and Triathler for measurement of Rn-222 in water.

2. Direct method for Rn-222 in water

Procedure:

- Add 12-18 ml of AquaLight cocktail in a standard 20 ml vial.
- Add 8-2 ml of water beneath the cocktail surface, i.e. cocktail + water volume 20 ml.
- Cap the vial tightly and shake until the mixture becomes translucent.

Hidex 300 SL

- Count with MikroWin 2000 parameter "Direct method for Rn-222 in water."
- Add the right water volume in the parameter calculation matrix.
- Open parameter options and change Alpha Specific parameters to the same than in Hidex 300 SL QA Report.
- The parameter should be registering alphaCPM.

Triathler

- Count with <Rn222> protocol, registering alphaCPM.

(A convenient choice is 14 ml AquaLight + 6 ml water. See the Note in the end of Result paragraph below for explanation).



Application note

HIDEX 300 SL™

Result:

The obtained alphaCPM can be converted to bequerels per liter (Bq/l) with the formula:

$$\text{Bq/l} = \text{alphaCPM} * 1 / (\text{E} * \text{V} * 60) \quad \text{where}$$

E = alpha counting efficiency (near 3, typically 2.8, because of Rn-222, Po-218 And Po-214)

V = water volume in the vial in liters.

For example, if the sample is 15 ml AquaLight + 5 ml water, V = 0,005 l, the values can be combined to a single multiplier (factor) $1/(2,8*0,005*60) = 1,19$ yielding:

$$\text{Bq/l} = \text{alphaCPM} * 1,19$$

(Note: with a sample of 14 ml AquaLight + 6 ml water, the factor becomes close to one and alphaCPM, as such, shows approximate Bq/l).

3. Extraction method for Rn-222 in water

Extraction allows very sensitive measurement because Rn-222 can be extracted from large water volume. The water volume should not exceed 10 * cocktail (MaxiLight) volume. Below is shown a method for counting with 20 ml vials. By adopting smaller volumes, it can be modified for minivials.

Procedure:

- Add max. 250 ml of water in an appropriate flask.
- Add 25 ml of MaxiLight cocktail on the water. Leave a small air pocket to facilitate shaking.
- Cap tightly and shake vigorously for at least 30 seconds.
- Wait for 3 hours until the phases separate and Rn comes in equilibrium with its daughters.
- Collect 20 ml of the cocktail into a standard LS vial and cap it tightly.

Hidex 300 SL

- Count with MikroWin 2000 parameter "Extraction method for Rn-222 in water".
- Add the right water volume and proportion of cocktail in the parameter calculation matrix
- Open parameter options and change Alpha Specific parameters to the same than in Hidex 300 SL QA Report.
- The parameter should be registering alphaCPM.



Triathler

- Count with <Rn222> protocol, registering alphaCPM.

Result:

The obtained alphaCPM can be converted to bequerels per liter (Bq/l) with the formula:

$$\text{Bq/l} = \text{alphaCPM} * 1 / (\text{E} * \text{V} * \text{T} * \text{P} * 60) \quad \text{where}$$

E = alpha counting efficiency (near 3, typically 2.8)

V = water volume in liters

T = transfer efficiency of Rn from water to cocktail (near 0,7 for 10-fold water excess)

P = proportion of cocktail collected.

For example, in the procedure above, the values can be combined to a single multiplier (factor) $1/(2,8 * 0,25 * 0,7 * 20/25 * 60) = 0,043$ yielding :

$$\text{Bq/l} = \text{alphaCPM} * 0,043$$

4. Useful keyboard operations for Triathler

During counting:

- key **0** toggles between alpha counts (A displayed) and beta counts (B displayed). Alphas are more informative and recommendable.
- key **9** toggles between:
 - C = accumulated counts
 - R = count rate (counts per minute, CPM)
 - D = CPM multiplied by result factor; (without any factor, D = R)

Setting a result factor:

- In **Ready** state of the <Rn222> protocol, press **Set** and then **Enter** until **Res. factor** emerges.
- Select **Yes**, type the numeric value (**Start** types the decimal point) and press **Enter**.

In this way, for the examples above, factor of 0.74 (direct method) or 0.043 (extraction method) can be programmed to directly yield Bq/l.



During counting, D (on key 9) then shows the factor result in the display. In the printout they come under DPM heading.

5. Spectral operations for Triathler (Commflier 1)

These are useful in assay set-up and control. They are not necessary in routine work with similarly prepared samples where numerical printout is adequate.

PC is required. See the manual for installation and instructions for the Commflier 1 PC interface software.

To send **two-dimensional (2D) spectrum** (x-axis: pulse height, y-axis: pulse length):

- After counting has stopped, but before exiting to Ready, press **3 Enter** on Triathler keyboard.
- After sending is completed, click **Insert 2D** (or **Insert Alpha** in some versions) on the Commands sheet.

In Excel 2D plot, x-axis is compressed by 16 and y-axis by 32. Therefore, when reading values from the 2D plot, multiply x-value by 16 and y-value by 32 to get the corresponding values for Triathler settings. For example, if you read from the 2D plot that optimal y-value for PLI is 12, you should type value of $32 \times 12 = 384$ in Triathler <Rn222> protocol. The PLI (pulse length index) should locate between alpha and beta regions for optimal alpha/beta separation. Typically, alphas are spotlike features above horizontal beta region.

To send **alpha (pulses above the PLI) pulse height spectrum**:

- After counting has stopped, but before exiting to Ready, press **4 Enter** on Triathler keyboard.
- After sending is completed, click **Insert Spectrum** on the Commands sheet.

To send **beta (pulses below the PLI) pulse height spectrum**:

- After counting has stopped, but before exiting to Ready, press **1 Enter** on Triathler keyboard.
- After sending is completed, click **Insert Spectrum** on the Commands sheet