Design and assessment of a water-analysis proficiency testing scheme

Asmaïl Asgadaouan[1] and Piet Speksnijder[1]

KWR Watercycle Research Institute
PO Box 1072, 3430 BB Nieuwegein,
The Netherlands

Corresponding author
E Asmail.Asgadaouan@kwrwater.nl
T +31 (0)30 60 69 595

1 KWR Watercycle Research Institute, Groningenhaven 7, 3433 PE Nieuwegein, The Netherlands

Introduction

KWR organizes since 1970's organic, inorganic and microbiological proficiency testing (PT) schemes in various water matrices. The organization of these PTs has been accredited by the Dutch Council for Accreditation under number R005 according ISO/IEC 17043.

KWR Proficiency Testings:

- consist yearly more than **40** laboratory test comparisons;
- offer **real** samples of different types of water, i.e. drinking, surface, waste, ground and swimming water;
- offer more than **250** different parameters (inorganic, organic and microbiological);
- present the results in table format and graphically.

Figure 1: collecting PT samples at KWR

Design of KWR PTs

Chemical PTs

The chemical PTs use the Youden-design. For each parameter at least two samples which are practically identical are distributed for analysis.
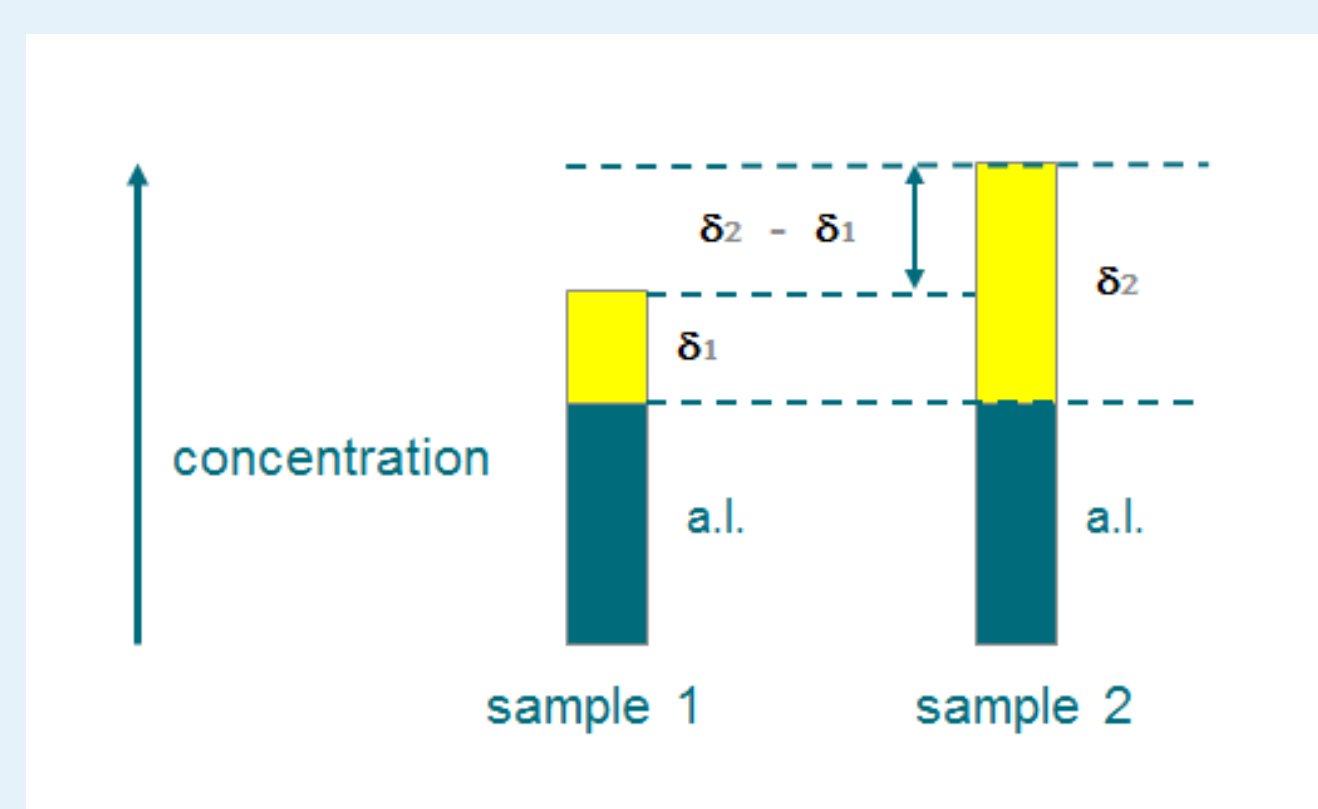

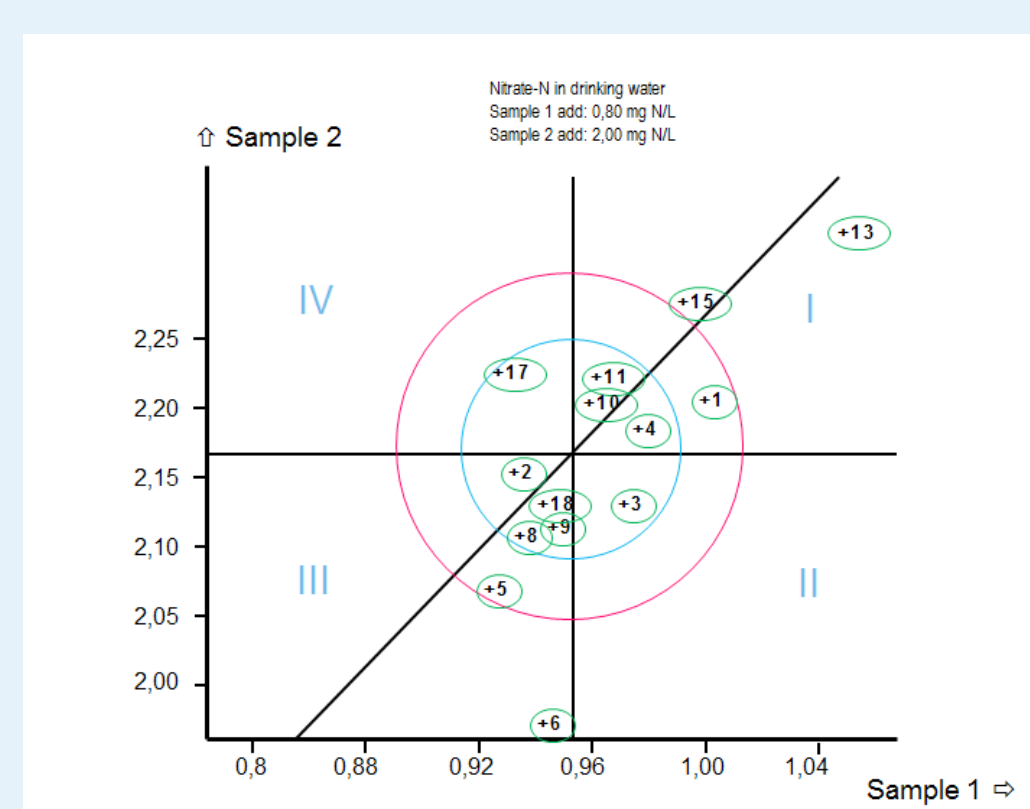*Figure 2: principal of a Youden-design*

Figure 3: example of a Youden-plot

The results of the participants give a good indication if deviating results are caused by systematic error and/or by relatively large random errors.
If the difference in the obtained concentrations between the samples of a Youden-pair is known (theoretical value), the accuracy for a large number of parameters also be assessed.

Microbiological PTs

The microbiological PTs offer the participants four different samples. This samples should be deployed within 36 hours. Each of the four samples is judged either by using the *standard* or *adapted* z-score depending on the type of organism. The standard z-score is based on the group average.
For the parameters *E.Coli*, bacteria of the Coli-group, enterococci, *Clostridium perfringens*, *Aeromonas*, *Legionella*, *Pseudomonas aeruginosa* and Staphylococci we calculate the adapted z-score. The *adapted* z-score is based on the average an the standard deviation from 50% of the 'highest'.

These four individual judgments obtained are further combined to one overall assessment of the laboratory performance, the so-called *overall judgement*.

Figure 4: countering of colonies on a plate

Assessment for KWR PTs

Chemical PTs

The assessment of KWR *chemical* PTs are based on group average and on the theoretical value.

Assessment based on group average:

Two samples for each parameter analyzed in a proficiency test. Individual assessment performed for each participant and sample using the following formula:

$$Z_i = \frac{x_i - \overline{x}}{s}$$

with x_i, the result of laboratory i, the group average and s the standard deviation of this results.

Assessment based on theoretical value:

Based on the z-score that is calculated using the theoretical value. The performance of the laboratory can be assessed using the following formula:

$$Z_{t,i} = \frac{(x_{i2} - x_{i1}) - (\delta_2 - \delta_1)}{s_r \sqrt{2}}$$

with the $(\delta_2 - \delta_1)$ addition difference between sample 2 and sample 1, and sr the repeatability standard deviation.

Microbiological PTs

The assessment of KWR microbiological PTs are based on group average (like chemical PTs) and average and the standard deviation from 50% of the 'highest' results.

Assessment based on the average and the standard deviation from 50% of the 'highest' results:

The performance of the laboratory can be assessed using the following formula:

$$Z_i^* = \frac{x_i - \overline{x}^*}{s^*}$$

With $\overline{x}^*$ the result of laboratory i, the average result and s* the standard deviation of the 50% highest results.

For the assessment the following criteria are being used:

- a good performance with regard to the group average when $|Z_i| \leq 2.0$;
- a moderate performance with regard to the group average when $2.0 < |Z_i| \leq 3.0$;
- a poor performance with regard to the group average when $|Z_i| > 3.0$

$Z_{g,i}$ -3   -2   + 2   + 3

Evaluation   Poor   Moderate   Good   Moderate   Poor
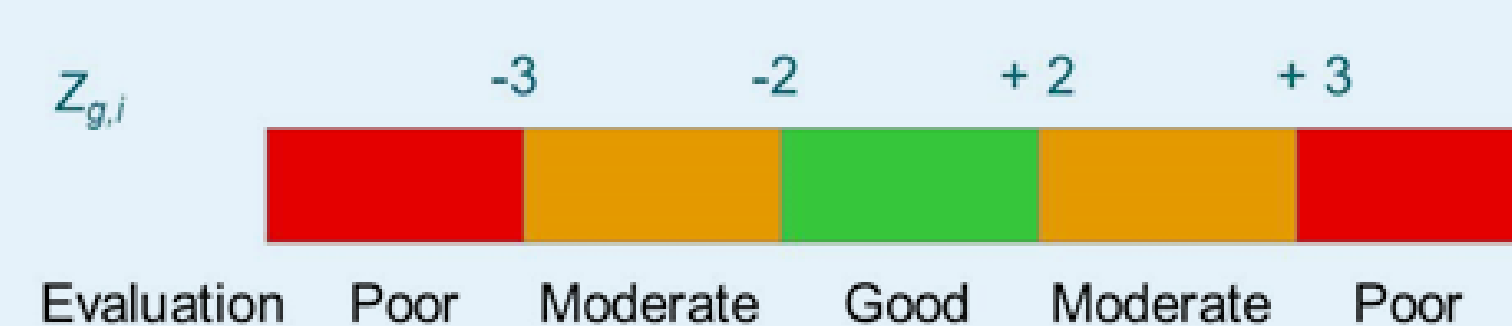
Summary

KWR Watercycle Research Institute organizes water-analysis proficiency testing schemes where both the design and the assessment of the chemical PTs compared to the microbiological PTs are different.

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