**INTRODUCTION**

The National Metrology Institute of Indonesia, National Measurement Standard, National Standardization Agency (SNSU-BSN) through the Laboratory of SNSU for Inorganic Chemistry has conducted an accuracy-based Proficiency Testing (PT) scheme for the mass fraction of Arsenic (As), Cadmium (Cd), Copper (Cu), Nickel (Ni), and Zinc (Zn) in bottled drinking water matrices based on ISO/IEC 17043:2010. The aim of the PT scheme was to evaluate laboratory capability in measuring minerals and contaminants in drinking water to comply with the implementation of Indonesian National Standard SNI 5535:2015 and the Regulation of Indonesian Ministry of Health No. 492/2010 regarding quality requirements of mineral and drinking water.

**METHODS AND PT EVALUATION**

The PT material was a candidate of certified reference material which was prepared by spiking a known weight of analytes into commercially bottled drinking water. The testing of homogeneity and stability on the material was performed and evaluated according to ISO 13528:2015 and ISO Guide 35:2017. Metrologically traceable reference values were used as the PT-assigned values (X₁), while the standard deviation for proficiency assessment (σ₁) was derived from the Horwitz model. The robust mean (x*) and standard deviations (s*) were also determined by Algorithm A with an iterated scale as a comparison.

**PT RESULTS**

The PT results showed that more than 80% of participants obtained satisfactory performance for Cu, Ni and Zn, while only 47% and 58% for As and Cd. The differences between the reference values and the robust mean of participants for As and Cd were found significant in the scheme. Information on unsatisfactory performance of laboratories within their claimed uncertainty means the laboratories need to re-check their uncertainty reasonability and escalate their capability in the uncertainty estimation for further enhancement.

**SUMMARY**

The PT results showed that more than 80% of participants obtained satisfactory performance for Cu, Ni and Zn, while only 47% and 58% for As and Cd. The differences between the reference values and the robust mean of participants for As and Cd were found significant in the scheme. Information on unsatisfactory performance of laboratories within their claimed uncertainty means the laboratories need to re-check their uncertainty reasonability and escalate their capability in the uncertainty estimation for further enhancement.

**ACKNOWLEDGEMENT**

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Christine Elishian, Isna Komalasari, Eka Mardika Handayani, Marlina O. Siahaan, Elsha R. Ayudianty
Laboratory of National Measurement Standards for Chemistry
National Measurement Standards National Standardization Agency of Indonesia (SNSU-BSN)
KST BI Habibie, Building 1101, Setu, South Tangerang, Banten, Indonesia

**Notes:**

HG-AAS = Hydride Generation – Atomic Absorption Spectroscopy
GF-AAS = Graphite Furnace - Atomic Absorption Spectroscopy
F-AAS = Flame - AAS
ICP-OES = Inductively Coupled Plasma – Optical Emission Spectroscopy
ICP-MS = Inductively Coupled Plasma – Mass Spectrometry

**Table 1. Summary of statistic and techniques used in the PT scheme**

<table>
<thead>
<tr>
<th>Analyte</th>
<th>X₁</th>
<th>u(X₁)</th>
<th>σ₁</th>
<th>x*</th>
<th>s*</th>
<th>Unit</th>
<th>Characterization Technique</th>
<th>Traceability to SI through</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>8.41</td>
<td>0.14</td>
<td>1.85</td>
<td>13.51</td>
<td>10.75</td>
<td>µg/kg</td>
<td>GSA*</td>
<td>SRM 3103a</td>
</tr>
<tr>
<td>Cd</td>
<td>3.06</td>
<td>0.07</td>
<td>0.67</td>
<td>5.97</td>
<td>4.05</td>
<td>µg/kg</td>
<td>IDMS**</td>
<td>SRM 3108</td>
</tr>
<tr>
<td>Cu</td>
<td>220.8</td>
<td>4.1</td>
<td>44.3</td>
<td>228.7</td>
<td>42.4</td>
<td>µg/kg</td>
<td>IDMS**</td>
<td>SRM 3114</td>
</tr>
<tr>
<td>Ni</td>
<td>60.7</td>
<td>1.0</td>
<td>13.3</td>
<td>56.8</td>
<td>12.3</td>
<td>µg/kg</td>
<td>IDMS**</td>
<td>SRM 3136</td>
</tr>
<tr>
<td>Zn</td>
<td>431</td>
<td>13</td>
<td>81</td>
<td>506</td>
<td>92</td>
<td>µg/kg</td>
<td>GSA*</td>
<td>SRM 3168a</td>
</tr>
</tbody>
</table>

*GSA: Gravimetry Standard Addition
**IDMS: Isotope Dilution Mass Spectrometry

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Fig. 1 Participants Test Results for (1) As, (2) Cd, (3) Cu, (4) Ni, and (5) Zn

Notes:

- GF-AAS
- HG-AAS
- F-AAS
- ICP-OES
- ICP-MS