Development of metrology for gas analysis at the Research Centre for Metrology-Indonesian Institutes of Sciences

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Abstract. Nowadays, in Indonesia, accurate and traceable of gas measurement data for product quality assurance, air environmental control and mitigation are demanding. The metrology in chemistry (MiC) research group, Research Center for Metrology-Indonesian Institute of Sciences (RCM-LIPI) in accordance with its duties and functions as the National Metrology Institute (NMI) continues to strive to develop its capabilities in answering such needs. In this presentation, we present the recent development of metrology activities in the field of gas analysis at the RCM-LIPI which includes infrastructure development (laboratory and instrumentation for gas analysis), development of reference gas mixtures (RGMs), and dissemination of prepared gas reference materials to end-used (stakeholders).

1. Introduction

Nowadays, in Indonesia, accurate and traceable of chemical measurement data for product quality, health, and environmental control are demanding. The metrology in chemistry (MiC) research group, Research Center for Metrology-Indonesian Institute of Sciences (RCM-LIPI) in accordance with its duties and functions continues to strive to develop its capabilities in answering such needs. As a part of metrology development in Indonesia for the purpose of keeping of chemical measurement traceability, the metrology in chemistry (MiC) laboratories conducts research and development of certified reference material in a wide range of fields, such as organic, inorganic, electrochemistry and gas. Specifically, gas metrology laboratory is developing reference gas materials (RGMs) used for gas analysis in the area of environmental air and clean energy that is expected to find uses in environmental control and mitigation. In this paper, we present the recent development of metrology activities in the field of gas analysis at the RCM-LIPI which includes infrastructure development (laboratory and instrumentation for gas
analysis), and the development RGMs, as well as the dissemination scheme of the prepared RGMs in Indonesia.

2. Infrastructure development

In order to support scientific and technological innovation in the field of MiC, the government of the Republic of Indonesia program ‘mission is by funding the development of the MiC infrastructure. Such a government program provides the infrastructure necessary to become an internationally recognized institute in the area of MiC research. Among the MiC research is metrology for gas analysis (also called as gas metrology). The gas metrology program’ primary focus is on the long-term modernization of gas metrology laboratory facilities including laboratory building (Figure 1) and analytical instruments (Table 1) to ensure that the laboratory has state-of-the-art facilities in support of gas metrology research.

![Facility location](image)

**Figure 1.** Facility location

| Instrument for gas reference material preparation | Instrument for gas analysis |
|--------------------------------------------------|-----------------------------|
| • Cylindrical actuation system for:              | • Gas chromatography equipped: |
| ✓ Small and medium capacity (2-10 L), and        | ✓ Pulse discharge ionization detector (PDHD) |
| ✓ Cylinder Evacuation System for large capacity (>10 L) | ✓ Flame ionization detector (FID)- methane and thermal conductivity detector (TCD) |
| • Gas filling system for inert, toxic and flammable gases. | ✓ FID-methane and electron capture detector (ECD) |
| • High precision weighing system (manual and automatic operating system). | ✓ FID and TCD with cryogenic system |
| • Machine for homogenization of prepared standard gas mixture | • Gas chromatography equipped with FID and TCD detector for extended natural gas analysis |
| • System for stability testing of prepared standard gas mixture | • Stream selection system for automatic gas sample injection system |
| | • Trace moisture analyzer |
| | • Gas analyzer equipped with nondestructive infra read (NDIR) technique for SO₂, NO, NO₂ analysis |
| | • UV photometric ozone (O₃) Calibrator |
| | • Gas analyzer equipped with magnet pneumatic technique for O₂ analysis |
3. Development of reference gas mixture

In fact, accurate and reliable data obtained from any analytical measurement is extremely required because the data is commonly used as the basis for decision making associated with many aspects in our daily life. Accurate and reliable data can only be achieved by well calibrated instrumental analysis using traceable reference standards. In the area of gas metrology (also called as metrology for gas analysis), the RGMs play an important role for obtaining valid and accurate data. Validity and accuracy of result from any gas analysis can only be obtained by using traceable RGMs which is indicated by an unbroken traceability chain (Figure 2).

The gas metrology laboratory promotes research through the development of reference materials according to ISO 6142 for wide ranges of gas analysis-related needs as the automobile, greenhouse gases, clean energy, stack gases, and ambient air. Taking importance of the national needs of RGMs over many years, we are initially working on the development of GRMs for automotive/vehicle emission, a GRMs for the calibration of instrument that is expected to succeed in helping to control the vehicle emission.

4. Dissemination of RGMs

One of the important roles of gas metrology laboratory, as a part of national metrology institute, is to disseminate traceability of measurement to the end-user. For this purpose, gas metrology laboratory should acquire the equivalence international recognition for the measurement and calibration capability through participation in inter-laboratory comparison in order to assure the unbroken chain of traceability measurement to SI (system international). Recently, the gas metrology laboratory has been participating in two international laboratory comparisons to achieve international recognize laboratory that is expected to succeed in near future. In addition, the dissemination of traceability of gas measurement is implemented by gas metrology laboratory through the use of secondary certified RGMs by RGMs producer for the certification of prepared working standard gas mixtures or used by testing laboratory as reference material for the calibration of measurement instruments. In addition, the dissemination of traceability measurement is also carried out through the proficiency test (PT) scheme for gas measurement that is organized according to the traceable reference value.
5. Conclusion
Development of gas metrology laboratory has been a remarkable success. With careful planning, gas metrology laboratory can leverage existing infrastructure, instrument and resources to create programs for fulfilling the national needs of traceable RGMs and for the internationally recognized institute.

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