Chemical Metrology in Hong Kong

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Abstract

Metrology in Chemistry, commonly known as Chemical Metrology, is the science concerned with studying and providing the basis for comparability of chemical measurements and their traceability. These are the two essential elements to establish global mutual recognition of analytical results thereby to provide a technical foundation for wider agreements related to international trade, commerce and regulatory issues. Comparability and traceability are usually established through participation in comparison studies conducted by internationally recognized metrology institutes and the use of internationally recognized reference materials. In the Hong Kong Special Administrative Region, the Government Laboratory is responsible for the metrology work in the chemistry discipline and serves as a linkage between the international and regional network of national metrology institutes and the local field laboratories regarding the establishment of comparability through participation in international comparison studies. Since September 2001, the Laboratory has totally participated in over 15 comparisons coordinated by the Asia-Pacific Metrology Programme (APMP) and the respective consultative committee of the International Committee for Weights and Measures (CIPM). Technically, a wide range of analytical scope including the analysis of environmental and food samples for contaminants, food constituent analysis, test for anabolic steroids in urine and DNA extraction has been covered. Indeed, to formalize our role as the metrology institute responsible for chemical metrology for our economy, the Government Laboratory has become a full member of the APMP in November 2004. In May 2005, HKGL has been included as a Designated Metrology Institute, in the field of metrology in chemistry for Hong Kong, China, under the Mutual Recognition Arrangement of the International Committee for Weights and Measures (CIPM MRA). In the days to come, the Government Laboratory will sure continue contributing to the development and prosperity of Hong Kong and to the international efforts in building a firm and harmonized technical foundation for international trade, commerce and regulatory issues.

1. Introduction

Chemical measurements provide us valuable information which is in fact indispensable in our daily life. For instance, with the reported analytical data, we know whether the foods sold in the market are safe for consumption or they might contain suspected carcinogenic substances or other harmful substances at levels exceeded the permissible limits. Manufacturers need analytical data to support claims of compliance of their products to the regulatory requirements for registration purposes. Governments make use of analytical data on environmental monitoring and health to formulae policies in respective areas. What if the analytical data we used are inaccurate?

For physical measurements such as length and mass measurement, an international metrology-based infrastructure and related activities have been in place for over a 100 year to ensure accurate, traceable and comparable measurements. For some reasons, however, similar systems had remained dormant in the chemical world until the early nineties. Indeed, the term “Chemical Metrology” or “Metrology in Chemistry” was first in use after the establishment of

the Consultative Committee for Amount of Substance – Metrology in Chemistry (CCQM) under the International Committee for Weights and Measures (CIPM) in 1993.

This paper outlines the basic concepts of Metrology in Chemistry and provides a brief account on its development under the present international metrology infrastructure. The paper also focuses on the pertinent activities that Government Laboratory (HKGL) participated in over the past few years and what are the results achieved. In addition, the role as a Designated Metrology Institute will also be discussed in the paper.

2. Metrology in Chemistry

Different from Physical Metrology, Chemical Metrology concerns the measurement of amount of substance and the related SI unit is "mole". The mole is defined as the amount of substance which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12. As such, the regime of chemical metrology covers all measurements related to determination of the amount of particular substances (chemicals) inside a system, for example, determination of organic pollutants in environmental samples or analysis of food samples for the presence of harmful substances.

The prime objective of Metrology in Chemistry is to provide the basis for comparability of chemical measurements and their traceability in order to establish global mutual recognition of analytical results and provide a technical foundation for wider agreements related to international trade, commerce and regulatory issues.

As part of the international infrastructure for Metrology, CCQM was established to address the international needs and technical issues related to Metrology in Chemistry [Figure 1]. The CCQM has about 40 member and observer organizations, including national metrology institutes, designated metrology institutes and international organizations such as WHO, IAEA, IUPAC, ISO REMCO, ILAC, etc.

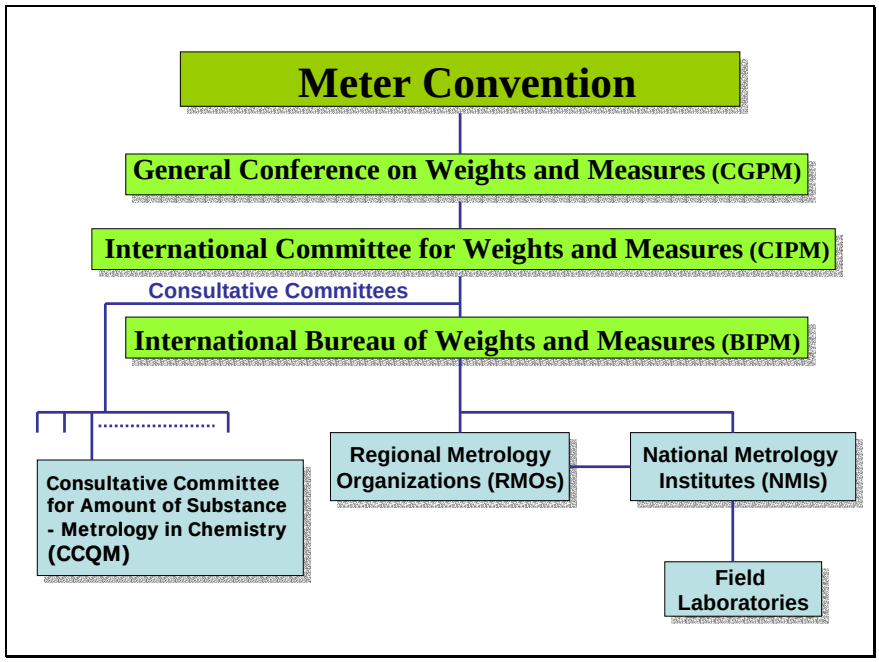

Figure 1: International Metrology Infrastructure

The aim of the CCQM is to establish world-wide comparability through traceability to the SI or other internationally agreed references. Comparability is the possibility to compare a measurement result obtained in country A with the result of the same type of measurement in country B. This does not mean it is necessary that all measurement and test results must have the same accuracy, but within the statement of uncertainty the results should be comparable. To facilitate the establishment of traceability chain, CCQM has activities taken place on the development of primary methods, primary pure reference materials and the validation of traceable methods. Other related activities include discussions on the quality and validity of the calibration and measurement capabilities and the certified reference materials claimed by the national/designated metrology institutes.

Comparability could also be established through participating in inter-comparison. In this regard, CCQM is responsible for the organization of key comparisons to assess the capabilities and the competences of participating national/designated metrology institutes. By coupling the CCQM key comparisons results with those of similar inter-comparison exercises conducted by regional metrology organizations, such as the Asia-Pacific Metrology Programme (APMP) for the Asia Pacific region, the capabilities and the competences of metrology institutes and designated institutes in the region could then be assessed and hence comparability be established [Figure 2].

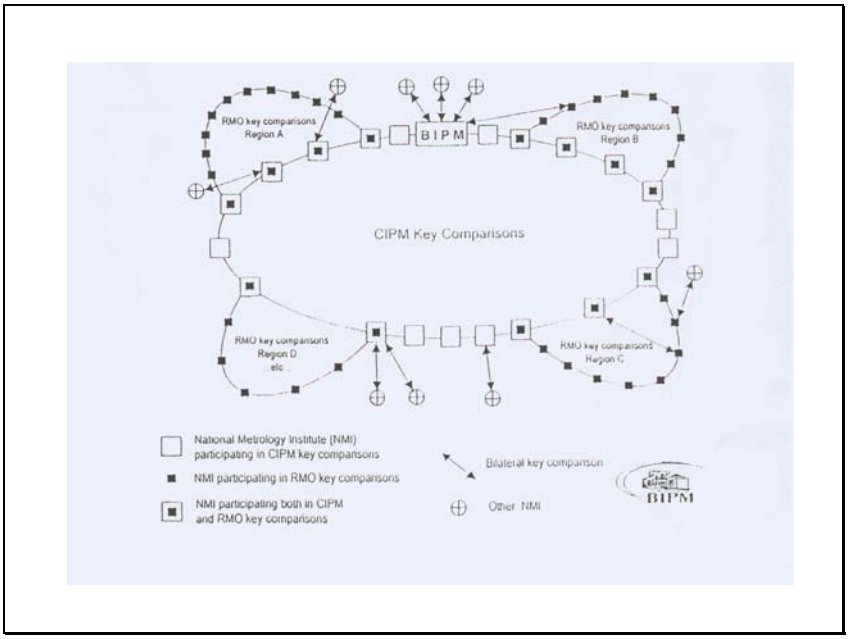

Figure 2: CIPM Key Comparisons Arrangement (with courtesy from BIPM)

3. HKGL's participation in chemical metrology activities

To formalize the role as the metrology institute responsible for the field of Chemistry within our economy, HKGL acquired a full membership of the APMP in November 2004. In May 2005, HKGL was included as a Designated Metrology Institute, in the field of Metrology in Chemistry for Hong Kong, China, under the Mutual Recognition Arrangement of the International Committee for Weights and Measures (CIPM MRA). Besides, HKGL is also a founding member of the Co-Operation on International Traceability in Analytical Chemistry (CITAC). Over the years, HKGL has actively participated in workshops and symposiums organized by CCQM, APMP, CITAC and other international

metrology organizations. HKGL has also kept close contacts with other national metrology institutes through regular participation in related meetings and technical exchange.

Since September 2001, the Laboratory have participated in over 15 inter-comparison programmes coordinated by APMP and CCQM respectively covering a wide range of analytical scope including the analysis of environmental and food samples for contaminants, food constituent analysis, test for anabolic steroids in urine and DNA extraction. As mentioned before, the inter-comparison programmes are ongoing activities to ensure traceability and international data comparability in chemical measurements among nations. So far, the results of HKGL were very good and this indicated that HKGL had attained a level of capability and competence that is comparable to those of the leading national metrology institutes such as NIST (USA), LGC (UK), NMIJ (Japan), NMIA (Australia), KRISS (Korea) and NRCCRM (China), and etc.

Proficiency testing programme is an important tool used by laboratory accreditation bodies to assess the competency of field laboratories. Successful participation in proficiency testing programme is often regarded as a demonstration of the validity of the laboratories' traceability statement in terms of measurement uncertainty. Under the auspices of the Asia-Pacific Laboratory Accreditation Cooperation (APLAC) and in collaboration with the Hong Kong Accreditation Service (HKAS), HKGL has organized a number of proficiency testing programmes for the analytical field laboratories in the region. Recently, programmes on the determination of toxic metals and pesticide residues in Chinese herbal medicine were organized, which had yet been available from other proficiency testing scheme providers [Figure 3].

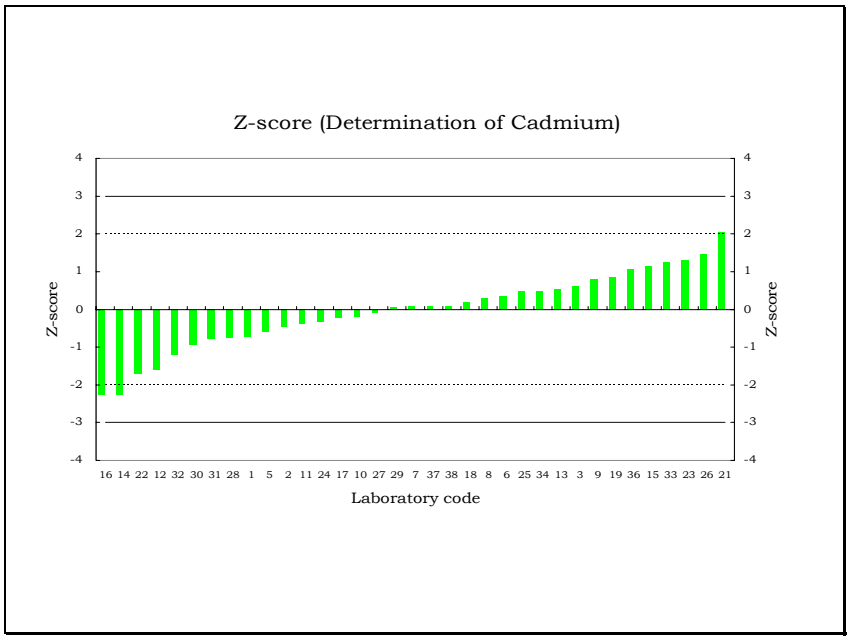

Figure 3: Results of Proficiency Testing Programme (Toxic metals in Chinese Herbal Medicine) conducted in 2004/05

4. Future development

As a designated metrology institute for our economy, HKGL will continue to promote awareness of metrology in chemistry, or in simple terms traceability, accuracy and

comparability of measurements, among government agencies and private sectors. Collaboration and resources will continue be sought to support developing measurement capabilities, promoting international/regional inter-comparisons and collaborating with international/regional metrology organizations.

To formalize its role as a quality proficiency testing schemes provider, HKGL is planning to seek accreditation to the ISO Guide 43:2000 from the National Association of Testing Authorities (NATA, Australia) in 2006. HKGL will explore the possibility of providing traceable assigned values to the proficiency testing programme so as to establish a traceability linkage with the global metrology system. Moreover, to take up the role as a reference laboratory, HKGL will continue to explore other metrology-based services required by the local testing community and the community at large for the betterment of the economy we serve.

References

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