

New types of infrastructure are needed for Chemical Metrology

Application of the principle approaches of traditional physical metrology is difficult in the case of Chemistry. Firstly there are a myriad of tests, analyses and measurements associated with the field all of which cannot be handled at the same time. Secondly most of the standards to be applied are substances that need to be carefully formulated and tested but the tests destroy the integrity of the standard so assessment is seldom possible on the standard to be employed. Storage of substances that maintains purity at the miniscule levels required is also difficult. Therefore simple measurement traceability chains like those used in mass measurement cannot work.

In mass there is one ultimate physical standard; the International Prototype kilogram made and stored in the laboratory of the international Bureau of Weights and Measures in Servrés Paris. Each country that signs the Meter Convention (The establishment of which we celebrate on world Metrology Day) receives a replica of the kilogram which they in turn use as their own mass standard which is used to calibrate local weights as standards down to the Legal Metrology Standards used to verify scales for everyday use. Each successive standard is calibrated by the standard just preceding it in the chain. In chemistry it is unlikely that such a simple approach would work.

Mass Standards are all weights



For example in the measurement of pH which is a measure of hydrogen concentration in water or acidity each level of standard is a different method of testing. The primary standard is an electrical arrangement called a Harned Cell. The secondary standard is a cell of a different type called a differential Cell. At lower levels chemical solutions of standard constituency and concentrations called Buffer Solutions are used. It is immediately clear that the use of the chemical standards requires different skills and facilities at different levels which immediately creates complications of traceability even though the measurement of pH itself is comparatively simple.

pH Standards have different forms

Harned Cell



pH Buffer Solutions



pH Meter



Also in Chemistry the substance in question is not the only one that is present. It is usually dissolved or attached to some solid, liquid or gaseous substrate. The combination may be a mixture, solution liquid or solid, an aerosol or some other form. There are also reagents that form part of the process to be used which are not necessarily part of the output of the test or measurement. The determination of mercury content from its ore cinnabar (HgS) is absolutely different from the determination of mercury contamination in fish.

Cinnaba



Mercury contaminated



Developing a national programme of Chemical Metrology is a complex process that needs quite a bit of groundwork.

1. Initially the tests, analyses, substances and substrates that are deemed critical enough for national interest need to be identified.
2. The facilities available for the performance of such tests need to be identified and competent reference laboratory facilities need to be designated, developed or created depending on the existing status.
3. The quality of the performance of the required methods or techniques need to be established through quality control schemes such as Proficiency Testing and consistently reviewed.
4. Appropriate standards need to be sourced to match the standard methods and techniques chosen.
5. During all of this there is the Specifications for the substances involved, raw materials, reagents, substrate and specimens can be established and put into laws, regulations and standards to ensure consistency wherever they are employed.

Laboratories can be accredited to these tests creating assurance of the expected quality in performance.

Trinidad and Tobago is a country that depends heavily on Chemical Tests and measurements for its industrial and social well being. As we develop our trading requirements and the need to improve the quality of life of our citizens and residents will increasingly demand improved Chemical Metrology Infrastructure.