

The quality of the measurements and the quality of life

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Abstract

The measurement must be finalised as much as possible to get precious informations about the evaluation the measurement wishes to perform. We need also that the procedure of measuring guarantees traceability and reliability, that means accuracy and possibility to be sure about the correspondence between experimental results and sample to be tested. In the case of the environment all this is still more critical as to the monitored data actions and rules follow, strictly depending on them. In some cases the environmental analysis are only qualitative due not only to defects of procedures but also to indexes not well chosen as markers of the environmental conditions. This is the case for instance of particulate matter and of the urban environmental stations.

Keywords: Measurement, quality, environment

Economy of the measures

Society is daily influenced by analytical measurements on which legal, commercial and social decisions are based. The accuracy of a chemical measurement is fundamental, depending on its purpose, but it becomes still more important when analysis concerns the state of the environment and human health. The measurements are a primary instrument of competitiveness as they guarantee the quality of a product or a service in comparison with other ones in the market. Adequate metrological systems of calibration, certification and accreditation are the basic instruments for any industrialised country, which wants and needs to be competitive in the international context. The existence of these systems guarantees the reliability of analytical results obtained in different laboratories so promoting the mutual recognition from different countries and avoiding useless, repeated analysis.

While other EU countries have managed and realised the improvement and the support of the measuring system by the creation of National Institutes dedicated to guarantee the quality of certified data, in Italy the situation is characterised by a certain delay. The analysis by the experts demonstrates that a significant part of the experimental data is not reliable leading to wrong assumptions and decisions so increasing economic damage (up to many billions of euros), for the decrease of the competitiveness of products, beside the still more dangerous aspect related to human health and environment.

Industrialised countries generally spend about 6% of their budget on measurements and related operations. Much of these costs are wasted as they duplicate analysis already performed and produce not reliable analytical data: it was estimated that each year about 25 million measurements performed in USA result in unreliable results, so needing to

be repeated at additional costs of 5 billions of euros. Similarly, in Germany it was estimated that due to the poor quality of data there was an added unnecessary cost of about 12 billions of euros; the approximately 30,000 laboratories in UK with 220,000 staff analysts perform one billion of experiments, corresponding to 30 measurements every second: of these about 20% do not fulfil the aim of the analysis, corresponding to about 3000 billions of euros lost.

Quality of measurement to protect human patrimony

The quality of the measurement is a necessary condition to safeguard the quality of life as both really refer and correspond to standards. The request of quality of goods and services, of foods and markets, of environment and health, seems to day almost peculiar, as new way if compared with the sparing behaviours of the past, basing on an international and global vision beginning to perceive the limits of resources. This seems the reason why the objectives of quality, even if attained by different approaches, tend to converge into a global agreement. This is particularly true in fields like environment and cultural heritage representing the richness and the treasures of human being. Scientists and researchers think that the analytical investigations on materials, systems and processes must sustain the research of quality during each phase from sampling to data treating. Among the most valuable critical positions for the exercise of this investigation there are those ones born inside the world of the analytical referentiation: systems, materials, process must be evaluated in comparison with references by applying suitable methods.

Environmental measurements

One might assume that the results obtained today are more reliable than those ones obtained in the past. This can be true. The techniques have been improved, instruments for the quality control are available and new methods have been set up. Nevertheless it is demonstrated that sometime the obtained data are unreliable. This evidence comes largely from interlaboratory studies where specialistic laboratories analyse the same samples. One problem is surely that the quality level of control applied in the past by the analysts for the measurements is not sufficient to satisfy the actual analytical problems. There are many reasons that can result into the production of wrong results: errors of computing, uncalibrated instruments, inaccurate methods or their inaccurate use (e.g. new pollutants determined concentration out of the useful range, interfering analytes not removed). When some modifications are introduced using a validated method, it is necessary to test its robustness, i.e. the ability not to loose accuracy and not to depend on the experimental conditions. For instance in the case of urban environmental stations their positions, the height from ground of the sensors, the handling of the systems, the maintenance are potential limits to the quality of the obtained data and consequently to the coherence to them of the following actions from the rulers.

An other aspect concerns the choice of the indexes to be measured: as it is not possible to measure anything everywhere we must address our attention to the most meaningful ones and this not always occurs. For instance particulate matters is only evaluated by its weight without any care of its nature, sulphur dioxide is measured to day as some years ago even if fuels to day are practically sulphur free, terpenic concentration used in many environmental models is never determined and radical even if considered an important marker of risk (oxidative stress) are still only object of attention from researchers, never from rulers and administrators of our cities.

References

- Currie, L. (1995) IUPAC, *Pure and Appl. Chem.*, Vol. 67 pp. 1699-1723.
- Farrant, T.J. (1997) *Practical Statistics for the Analytical Scientist*, Cambridge, UK: The Royal Society of Chemistry.
- Horwitz, W. (1988) *Pure and Applied Chemistry*, Vol. 60, pp. 855-864.
- Horwitz, W., Kamps, L. and Boyer, K.W. (1980) *J. Assoc. of Anal. Chem.*, Vol. 63, p. 1344-1347.
- Ingamells, C.O. (1974) *Talanta*, Vol. 21, pp. 141-155.
- Ingamells, C.O. and Switzer, P. (1974) *Talanta*, Vol. 20, pp. 547-568.
- ISO (1993) *International Vocabulary of Basic and General Terms in Metrology*, Geneva.
- ISO 3534-1 (1993) *Vocabulary and Symbols: Part I, Probability and general statistical terms*.
- ISO 5725-1 (1994) *Accuracy Trueness and Precision of Measurement Methods and Results: Part I. General principles and definitions*.