New CMI standard of amount of substance.

*Mol* is a basic unit of amount of substance (quantity of matter), one of the 7 base unit of the International System of Units SI. Measurements related to amount of substance (chemical measurements) are among the most widespread measurements at all - even if in comparison with physical measurements they are generally less accurate (relative uncertainties of such measurements are at best of the order of 10-5 to 10-6).

Coulometry as a primary method to determine the amount of substance has a unique role for national metrology institutes in an international context, it is used e.g. for certification of pure substances – primary reference materials having a composition with a combined uncertainty of the contents of the main substance under 0.01%, eventually of solutions of pure substances without a disruptive matrix. It serves to a realization and dissemination of the unit of amount of substance using primary certified reference materials. A reference material is a material, sufficiently homogeneous and stable with respect to one or more specified properties, which has been established to be fit, inclusive its accuracy, for its intended use in a measurement process: for verification or calibration of measuring instruments, for validation of measurement methods and for determination of quantitative material properties.

Coulometry is based on a direct or indirect electrochemical transformation of the matter to be determined. Chemical reactions on working electrodes have to take place with a 100% current efficiency, only one reaction can be in progress at any given time at any electrode. Interfering side reactions can take place, e.g. a dissolution of the solvent (e.g. water), a dissolution of an electrode (e.g. a dissolution of a mercury electrode in a highly acid solution) etc. To a complete electrochemical transformation of the amount of substance (“number of moles”) *n* an electrical charge *Q* is need the value of which is given by the Faraday´s law: *Q = n z F* (where *z* is the charge number of the electrochemical reaction – the valency number of ions of the substance - and *F* is the Faraday constant). Therefore, the determination of the amount of substance is directly related to other SI base units and does not require a comparison with a reference material.

Last year CMI put in operation a highly accurate coulometric set-up which will be serve as a national standard of the amount of substance. The composition of this high-precision coulometric set-up (High precision coulometry equipment) is as follows:

- current source (parameters: range 1-4000 mA; stability (24h) 5 μA; noise 0.5 μA; timer 0 – 10000 s; uncertainty of the time interval better than 0.1 ms),

- indication unit (parameters: both potenciometric and ampermetric 3-electrode indication, galvanic disengagement of electrodes; ±1,5 V; RS-232).

Other integral components of the coulometer are: ventilation unit, piston burette, exchangeable unit, controlling computer with communicative transducers and the SW.

This primary standard will primarily be used for certification of primary reference materials of amount of substance with a direct determination of the main substance (purity). These reference materials can subsequently be used to establish traceability of measurement results in various chemical measurements.

A detailed picture of the new standard of the unit of amount of substance *mol*

