Atomic Spectroscopy- The Short Course Organiser's Approach

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The current situation in the UK for flame, furnace and ICP atomic-absorption methods appears to be that short courses are run by the water industry, various instrument manufacturers and some academic institutions. The Water Industry Training Association (WITA) run about twelve courses each year on AAS. These consist of about five basic courses (application of AAS to analyses in the water industry) and a total of seven courses on the analysis of potable waters and the analysis of effluents and sludges, all by AAS. The courses are 3–4 days in length. About five of the major manufacturers between them run some 30 basic AAS courses per year (2–3½ days), with about 20 to 25 ETA courses. Courses on "top of the range" AA and ICP can be conducted at the purchaser's premises. The Polytechnic of North London puts on three courses (3–4 days), a general applied atomic spectroscopy course (every 3 or 4 years), an AAS course (every 1 or 2 years) and an ICP course (every 2 or 3 years). UMIST runs an ICP course (2 days) every year and Loughborough University of Technology (LUT) runs an AAS course (4½ days) every year.

Aims of the Courses

Atomic Absorption

Instrument manufacturers

The aims of these courses are as follows.

1. The primary aim is to teach participants (mostly purchasers) how to use the instrument, the view being taken that effective use will only be made of the instrument (thereby showing it off in the best possible light) if the user understands how the instrument works and what the problems are going to be.
2. To teach the basic theory of atomic absorption.
3. To teach the basic principles of instrument design.
4. To teach the mechanisms of common interference effects and how they can be overcome.
5. To teach the principles of various atomisation devices (flames, furnaces, hydride generation, etc.).

Academic courses

In addition to the above aims the academic based courses also aim to achieve the following.

6. To put AA in perspective with other atomic-spectroscopy techniques.
7. To provide in-depth evaluation of instrument performance.
8. To discuss recent advances and likely future developments.
9. To provide examples of the applications of AAS.

WITA courses

These courses cover the basic aims 1–4 above, together with detailed consideration of the application of the technique to the analysis of clean and dirty water.

Instrument manufacturers' ETA courses

These courses tend not to teach comparative atomisation methods but have the other basic aims, the assumption being that participants will have already attended a basic (flame) course.

ICP courses

Instrument manufacturers do not run courses as such but provide on-site training (in instrument operation) for purchasers. The UMIST and PNL courses aim to provide an extensive introduction but do not provide operator training. The courses cover basic principles and theory, instrument design, interferences (in nebulisation), applications, other plasmas (MIP, DCP), recent developments and future trends. North London Polytechnic gives perhaps slightly more emphasis to the fundamental aspects of plasma processes and spectrometer design, with UMIST giving more emphasis to sample introduction and attendent problems.

The aims of the various courses can be summarised as: instrument manufacturers, training in how to operate and optimise; WITA, as above plus how to analyse waters and sludges; academics, as above plus an understanding of the underlying principles, comparison and evaluation.

Format of the Courses

Flames and ETA

Despite the differences in aims, the formats of the various courses are remarkably similar; namely a mixture of lectures (with the occasional tutorial) and practical work, with the allocated time split about 50 : 50 between the two activities. Extensive documentation is also supplied. Instrument manufacturers use their own instruments and personnel, whereas the other courses use a mixture of this and external lecturers, with additional instruments on loan for the course. There appears to be excellent co-operation between the relevant companies and WITA and the various academic institutions.

ICP Courses

Despite valiant efforts by the organisers involved, it does not appear possible to adopt the same format for ICP as for AA. The reasons appear to be: (*a*), the institutions do not have enough of their own equipment to provide useful hands-on training; (*b*), not enough space can be made available to accommodate a large number of instruments; and (*c*), instruments are large and difficult to transport, install and get running reliably, and therefore manufacturers are reluctant to loan them. Two formats have been tried: firstly, a mixture of lectures plus trips to nearby instrument manufacturers or ICP users for demonstration sessions; and secondly, intensive

lectures, tutorials and discussion sessions supplemented by extensive documentation.

Content of Courses

Instrument Manufacturers' Basic Course

These consider principles, instrument design, calibration, optimisation, interferences, background correction, basic ETA, sample preparation, hydride generation, cold vapour mercury and discrete nebulisation.

Instrument Manufacturers' ETA Course

Instrument design, method development, interference effects, background correction, minimising contamination and trouble shooting are covered.

WITA

These are as for the instrument manufacturers' basic course, minus the specialised atomisation techniques but plus some relevant applications.

North London Polytechnic AA Course

This course is as for the instrument manufacturers' courses but with less practical work.

ICP Courses

On these courses the origin of spectra, local thermal equilibrium, line shape, temperature, plasma properties, torch design, spectrometers, nebulisers, optimisation, nebuliser interferences, spectral interferences, calibration, evaluation of performances, other sample introduction methods, other plasmas, ICP - MS, other recent developments, applications, limitations and costs are discussed.

The LUT AA Short Course

The general philosophy behind all of the short courses that we run in the Chemistry Department at LUT is: firstly, to promote links with industry through contact with course members, instrument manufacturers and related companies; secondly, to keep abreast of instrumental developments; and thirdly, to make money! The money does not go into the organisers' pockets, but is used to employ much needed support staff, send academic staff and research students to meetings and conferences, buy small items of equipment, books, subscriptions to journals, etc.

In running these courses we recognise that it is not possible to please all of the participants all of the time, given the wide differences in backgrounds and reasons for attending the course. However, the aims (see earlier) are clearly set out in the descriptive brochures, and there should not be anyone on the courses who will not be pleased at least some of the time. Within the basic lecture - practical format there are plenty of opportunities for discussion between course members and external tutors.

The sequence of topics covered in the lectures is basic theory, basic instrument, flames, interferences, calibration, ETA, background correction, hydride generation, instrument design, optimisation, instrument evaluation, ICP, recent developments in flame techniques, atomic fluorescence, comparison of atomic-spectrometric techniques, applications. As far as is possible, acknowledged experts are invited to give the lectures; thus, in addition to LUT staff, there are some ten or eleven external lecturers. Inevitably there is some overlap between speakers, but this is considered to provide reinforcement of ideas rather than as boring repetition. The lecture - tutorial hours total 17.

Just as there is considerable agreement between course organisers on the basic format and content of lectures, there is also agreement on the nature of the basic experiments. The LUT course has set experiments on the effect of operating parameters, interferences, calibration and detection limit, background correction, use of the dinitrogen oxide - acetylene flame (in AA and AE), ETA, flow injection and hydride generation. Other courses include experiments on solvent extraction, fault finding, use of an autosampler, the Delves cup, reducing sensitivity and nebuliser adjustments. The LUT practical timetable is highly structured to start with and then becomes more flexible to allow participants (*a*) to use a particular manufacturer's equipment, (*b*) extended use of a particular technique, (*c*) to run their own samples, (*d*) discussion with course tutors. The practical work occupies some 14 hours of which 4 are optional.

The course runs under a number of constraints. The timing is set by the availability of the laboratory space (only during vacations) and the requirements to run about 6 courses on a variety of analytical techniques during the year. No allocation of time is given to organisers; the organisation and running has to be fitted in with other demands. There is a limit to the number of instruments that can be made available and hence the numbers of participants (not more than three per instrument) and the external speakers are not always available either.

Conclusions

With regard to AA, there is obviously a considerable demand for basic operator training courses as purchasers prefer to have their operators trained by the manufacturers rather than do it themselves. This makes sense, as the manufacturers do a good job and the minimum number of the purchaser's personnel are involved in non-productive work. There is a more limited demand for a broader (and usually longer) course, which provides education as well as training. As far as ICP is concerned, the education and training aspects are separated. There is a limited demand for the intense education course.

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