European Cooperation in the field of Scientific and Technical Research
- COST -

Secretariat

Brussels, 11 July 2006

COST 259/06

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding (MoU) for the implementation of a European Concerted Research Action designated as COST Action 637 Metals and Related Substances in Drinking Water’

Delegations will find attached the Memorandum of Understanding for COST Action 637 as approved by the COST Committee of Senior Officials (CSO) at its 165th meeting on 27/28 June 2006.

MEMORANDUM OF UNDERSTANDING
FOR THE IMPLEMENTATION OF A EUROPEAN CONCERTED RESEARCH ACTION
DESIGNATED AS

COST ACTION 637

'Metals and Related Substances in Drinking Water'

The signatories to this "Memorandum of Understanding', declaring their common intention to participate in the concerted Action referred to above and described in the 'Technical Annex to the Memorandum', have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 400/01 'Rules and Procedures for Implementing COST Actions' or in any new document amending or replacing it, the contents of which the Signatories are fully aware of.

2. The main objective of the Action is to stimulate better control of metals and related substances in drinking water and to minimise environmental impacts.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at approximately EUR 50 million in 2005 prices.

4. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

5. The Memorandum of Understanding will remain in force for a period of four years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter 6 of the document referred to in Point 1 above.

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COST ACTION 637

Metals and Related Substances in Drinking Water

A. ABSTRACT

The revised EU drinking water directive (98/83/EC) sets a range of standards for metals and related substances in drinking water, many of which are concerned with health protection. A number of these standards have been tightened and the revised directive more clearly requires compliance to be assessed at the point of use. There are a number of difficulties associated with monitoring, and historic practices have tended to focus on the quality of water within the distribution network. In consequence the magnitude of problems with some metals and related substances in drinking water is not fully appreciated in all European countries, and the extent and nature of corrective actions differ widely.

The COST Action addresses these problems through four working groups that focus on (1) plumbosolvency control, (2) cuprosolvency control, (3) other metals and related substances, including arsenic and nickel, and (4) the socio-economic and environmental impact of corrective measures. The working groups will stimulate much-needed knowledge exchange within Europe through the organisation of workshops and conferences, training and exchange visits. They will also organise demonstration studies and develop a programme of collaborative research. A better understanding will be gained of the possible impact of metals and related substances on human health and the measures needed for control.

Key words: metals, drinking-water, monitoring, control, health.

B. BACKGROUND

The contamination of drinking water by metals occurs throughout the 'source–to-tap' production and delivery system. Some contamination is fairly easy to identify and resolve but some much less so. The EU drinking water directive (98/83/EC) sets mandatory health-related standards for seven metals (Sb, Cd, Cr, Cu, Pb, Hg, Ni) and two metalloids (As, Se), and more discretionary limits for a further four metals (Al, Fe, Mn, Na). The topic encompasses a range of issues that reflect the occurrence of metals and metalloids in source waters, the use of metals in treatment, the use of metals in the fittings and pipes associated with the supply of drinking water to consumers, the use of metals in appliances, and the chemicals used in corrosion control. While some issues are straightforward, others are inherently complex and difficult to handle. There are several key issues and these are summarised below.

Lead

The EU drinking water directive (98/83/EC) sets more stringent standards for reducing lead in drinking water in order to protect public health: 25 µg/l became a legal requirement at the point of use (kitchen tap) in December 2003, tightening to 10 µg/l in December 2013. To achieve these standards requires either the replacement of all lead pipes (both those owned by the water company and those owned by the householder – about EUR15 billion in the United Kingdom alone and possibly ten times that amount in Europe) or the continuous dosing of a corrosion inhibitor (ortho-phosphate). Corrosivity testing demonstrates that if lead pipes are present, corrective action is needed for the great majority of water supplies, a position not fully appreciated by many stakeholders in Europe. Up to 75% of the dwellings in older towns and cities in Europe are being supplied with drinking water via a lead pipe.

The UK has widespread experience in ortho-phosphate dosing whereas the Netherlands embarked on a nation-wide lead pipe replacement campaign. Phosphate dosing is being evaluated in France and Portugal and partial lead pipe replacement (i.e. those owned by the municipality or water supplier) has been advocated in some other EU countries. Some EU countries have limited experience in the issue, because historically they have not sampled drinking water at consumer points of use (preferring to sample from the water distribution network prior to any lead piping) and so have not yet fully determined the extent of their problems. There are also concerns about the environmental impact that ortho-phosphate may have on receiving water bodies (rivers etc), albeit such concerns are generally not quantitative and may have been overstated.

In consequence, an important issue has not yet been progressed fully in many parts of Europe, possibly placing these areas at risk of enforcement action by the European Commission. The link between lead ingestion and health impact has been demonstrated by epidemiological studies (in various parts of Scotland) with measured reductions in some aspects of child development (e.g. IQ and size) linked to the metal. The health impact of lead has not been quantified at the European level although its relevance to health is generally acknowledged.

Copper

The directive (98/83/EC) also reduced the standard for copper in drinking water to 2 000 µg/l (from 3 000 µg/l) in recognition of possible health effects, and four EU countries have adopted an even more stringent national standard (1 000 µg/l). Historically, copper in drinking water has been viewed as an aesthetic issue, related to the green staining of sanitary appliances and clothes from washing. The health concerns relate to the potential to cause nausea and recent claims of a causative effect in Alzheimer's disease (although another research project concluded that copper had a protective effect!). In its first five-yearly review of the directive in 2003, the European Commission resisted pressures to further reduce the copper standard, preferring member states to restrict the use of copper piping in 'high priority' areas. Currently, there is an untested proposal for defining 'high priority', but the status of this proposal is uncertain.

Cuprosolvency (copper) control is much less well developed than plumbosolvency (lead) control and is currently dominated by testing methods based on pipe rigs, although the results do not all appear to have been validated by sampling at consumer points of use. There is considerable scope to further develop cuprosolvency control techniques and to confirm what is meant by 'high priority', and in so doing to ensure the continued but appropriate use of a material widely used in Europe.

Arsenic

Historically, arsenic was not considered to be a problem but when the earlier drinking water directive of 1980 was revised in 1998, the former standard of 50 µg/l was tightened to 10 µg/l. This new limit is exceeded by some groundwaters in contact with volcanic rock, as found in parts of England, Hungary and possibly elsewhere. Treatment systems using an iron-based adsorbent have been developed but experience is limited.

Aluminium, iron and manganese

Aluminium, iron and manganese are often found in soft upland water sources associated with natural organic matter, particularly humic and fulvic acids, and can be removed fairly readily by physico-chemical treatment. Iron and manganese are also commonly found in the deoxygenated groundwaters abstracted from confined aquifers and can be treated by a range of physico-chemical and biological filtration processes. The municipal treatment systems deployed derive benefit from their larger scale, particularly in relation to control, but the processes used are less suitable for the numerous small supplies found throughout Europe in rural areas. Aluminium and iron coagulants are used in the treatment of surface derived waters (rivers, lakes, reservoirs) to remove organic colour and fine particulates and if process control is poor then residual metal concentrations can be significant and contribute to aesthetic quality problems. The commonest source of iron in drinking water is from old corroded cast-iron water mains, historically the material used most commonly in supply networks. Replacement and refurbishment is very expensive and the major challenge is how best to prioritise available expenditure. Sophisticated network modelling and asset condition assessment techniques have been used in the more developed water supply systems and there is considerable potential for such tools to be adopted throughout all of Europe.

Sodium

Sodium can be a problem with groundwaters close to the sea (or connate saline water) when abstraction pumping pulls saline water towards the point of abstraction. Surface water abstractions from rivers that are close to the tidal limit can be similarly affected. The common solutions are to develop alternative water supply sources or to opt for desalination treatment using ion-exchange processes, the latter having to be considered more often in areas suffering from water supply stress (e.g. London). Sodium can also arise from the use of home-based water softeners and there has been much debate recently about whether or not the drinking of softened water should be permitted.

Nickel

Nickel, which can have allergic effects, is not normally found in source waters but may arise from the internal surfaces of stainless steel taps and from the stainless steel heating elements of kettles. European proposals for standardisation of water supply fittings are expected to result in the withdrawal of nickel coatings in direct contact with drinking water but do not cover consumer appliances. The full extent of nickel problems in drinking water supplies is not currently known.

Monitoring and its relevance to policy and practice

With the development of more sensitive analytical methods and the general adoption of analytical quality control procedures, water analysis for metals and related substances is no longer a major issue. The problems relate to how samples are taken. As a general rule, spot samples taken at a reasonable frequency will adequately characterise the metals found in source waters and those metals added or removed in water treatment. It becomes much more difficult to characterise the metals that arise either from the piped distribution network (e.g. Fe) or from the pipe-work, fittings and appliances in buildings (e.g. Cu, Ni, Pb), because the interactions with water vary greatly, both spatially and through time, and it should be noted that the minimum required sampling frequencies of the directive are very low. The three main sampling methods used are summarised below and can give very different results:

(i) random daytime sampling: dwelling selected at random and first draw sample, without flushing, taken from the point of use (kitchen tap);

(ii) routine spot sampling from selected points considered to be representative of the supply as a whole – such points have often not included points of use.

(iii) stagnation sampling at selected reference points or using pipe rigs – the sample is taken after a specified contact time with the metal pipe.

There is no doubt that such differences and low sampling frequencies explain why some European countries perceive problems and others do not, and why corrective measures vary so widely. A harmonised monitoring scheme was to have been established by the European Commission for copper, lead and nickel but it is understood that legal complications have hindered progress. However, a discussion paper from the Commission has indicated a clear preference for random daytime sampling (and has advocated more frequent sampling). The resolution of sampling difficulties will enable better risk assessments, of the relevance of metals and related substances to human health to be attempted.

Why a new COST Action is needed

Overall, there is a significant need to prompt better technical knowledge exchange and further research in Europe on the range of issues relating to metals and related substances in drinking water, being of considerable social, health, environmental and economic importance. The major benefit of the COST Action is the establishment of a comprehensive and active network for the stimulation of research and demonstration studies, enabling valid approaches and best practice to become much better known throughout Europe, and enabling better assessment of the possible impact of metals and related substances on human health in Europe.

The earlier and far broader WEKNOW network on drinking water quality, funded by the EU's Sixth Framework Programme, was successful in identifying the importance of metals in drinking water (amongst many other issues), but came to an end in mid-2005. However, strong support emerged from the WEKNOW activities for this

Action. The integrated project TECHNEAU, also funded by FP6, that has since been initiated is focusing on water treatment and has little relevance to metals in drinking water, a position confirmed by representatives of its management board. There is no significant duplication of either recent or current COST Actions and this COST Action therefore fits in well with other European initiatives, both past and present.

C. OBJECTIVES AND BENEFITS

The main objective of the Action is to stimulate better control of metals and related substances in drinking water and to minimise environmental impacts.

Supporting objectives

[1] To provide an on-going forum for knowledge exchange in connection with metals and related substances in drinking water.

[2] To promote good practice in the control of metals and related substances in drinking water.

[3] To more critically determine the environmental and socio-economic impacts of control measures through the sharing of practitioner experience.

[4] To stimulate relevant collaborative research and demonstration studies at the European scale.

Benefits

[1] The greater normalisation of approaches for dealing with metals and related substances in drinking water, with due regard for the local context.

[2] A significant increase in compliance with the standards for metals and related substances that are set by the EU Directive (98/83/EC).

[3] In the case of lead in drinking water, greater public health protection across Europe .

[4] In the case of copper in drinking water, clarification of any need to restrict the future use of copper piping.

[5] In the case of metals in drinking water more generally, the gathering of information of potential relevance to the impending implementation of the European Acceptance Scheme for construction products in contact with drinking water.

D. SCIENTIFIC PROGRAMME

The scientific programme will be broken down into four manageable topic areas, each topic area being the focus of a working group. Common activities, particularly the acquisition of information by questionnaire (or other survey technique) will be coordinated by the Management Committee to avoid duplication of effort. National clusters of relevant organisations will greatly assist in information gathering as well as facilitating dissemination. The four topic areas are:

Plumbosolvency control (Working Group 1)

The topic area is justified by the complexity of this single issue and its importance on how best to deal with a widespread problem of historic origin. The following scientific aspects will be covered:

- the occurrence of lead piping and the evidence for lead in drinking water problems will be reviewed;
- causative factors will be evaluated, particularly water quality influences (such as organics);
- the suitability of various sampling methods will be further evaluated by reference to practitioner experience and the risks of coming to erroneous conclusions about regulatory compliance will be assessed;
- the availability of other investigative techniques will be reviewed;
- the relevance of metal speciation will be reviewed;
- collaborative research will be promoted, particularly in relation to improvements in investigative techniques (for example, refinement of zonal emission modelling methods);
- demonstration studies will be promoted, which use the range of control methods available within a clearly structured investigative framework and which include an appropriate range of circumstances (water quality, type of housing stock etc.);
- state-of-the-art reports and appropriate codes of practice will be prepared;
- potential risks to human health arising from lead in drinking water will be assessed, in the light of the above.

There is already sufficient information about the behaviour of pH and alkalinity in relation to lead solubility so that further work on this aspect is unlikely to be necessary.

Cuprosolvency control (Working Group 2)

The topic area is justified by the complexity of this single issue, by the continued widespread use of this material and by the major uncertainties about its future use. The following scientific aspects will be covered:

- the occurrence of copper piping and the evidence for copper in drinking water problems will be reviewed;
- causative factors will be evaluated, particularly water quality influences (such as pH, alkalinity and organics);
- the suitability of various sampling methods will be further evaluated by reference to practitioner experience and the risks of coming to erroneous conclusions about regulatory compliance will be assessed;
- the availability of other investigative techniques will be reviewed;

- the relevance of metal speciation will be reviewed;
- collaborative research will be promoted, particularly in relation to improvements in investigative techniques (for example, development of rapid cuprosolvency test procedures, development of zonal copper emission models);
- a scientific basis for restricting the future use of copper pipe-work will be considered;
- state-of-the-art reports and appropriate codes of practice will be prepared;
- potential risks to human health arising from copper in drinking water will be assessed, in the light of the above.

Other metals and related substances (Working Group 3)

The focus will be on arsenic removal, the control of iron discolouration from water mains, determining the significance of nickel, and the ramifications of the European Acceptance Scheme. The following scientific aspects will be covered:

- the occurrence of arsenic problems and the performance of corrective treatments will be evaluated;
- the extent of nickel problems and causative factors will be reviewed;
- the extent of iron discolouration problems and the scientific methods used in remediation will be reviewed;
- the suitability of various sampling methods will be further evaluated by reference to practitioner experience and the risks of coming to erroneous conclusions about regulatory compliance will be assessed;
- the availability of other investigative techniques will be reviewed;
- the relevance of metal speciation will be reviewed;
- collaborative research will be promoted, particularly in relation to improvements in investigative techniques (for example, development of rapid nickel-solvency test procedures);
- a scientific basis for restricting the future use of nickel in water fittings will be considered;
- state-of-the-art reports and appropriate codes of practice will be prepared;
- potential risks to human health arising from other metals and related substances in drinking water will be assessed, in the light of the above;
- the relevance of the European Acceptance Scheme will be tracked as it is implemented.

The occurrence in drinking water of the other metals and metalloids included in Directive 98/83/EC (that is: Sb, Cd, Cr, Hg and Se) are considered to be much less of a problem, but will be assessed for significance.

Environmental and socio-economic impacts (Working Group 4)

The topic area is justified by the scale of the issues, particularly plumbosolvency control involving the use of phosphate corrosion inhibitors, and the common ambition to find sustainable solutions to problems with metals and related substances in drinking water, for the maximum benefit of the European society and its environment.

The following scientific aspects will be covered:

- the environmental impact of the widespread dosing of ortho-phosphate (and other corrosion inhibitors) to water supplies will be quantified as far as possible by reference to practitioner experience;
- the environmental impact of metal residues in drinking water will be evaluated in relation to sewage sludge disposal routes;
- the environmental impact of widespread lead pipe replacement will be evaluated, particularly for city and town environments (disruption to water consumers, disruption to communities, disposal of old pipes, etc.);
- collaborative research will be promoted, particularly in relation to the better quantification of environmental and socio-economic impacts (for example, the development of catchment or city-wide impact models, further evaluation of public health impacts (as appropriate), quantification of the commercial impact of restrictions, etc.);
- state-of-the-art reports and appropriate codes of practice will be prepared.

E. ORGANISATION

The structure of the Action is illustrated in Figure 1, with the four working groups (WGs) following the sub-division of the topic, as outlined in Section C.

The Management Committee (MC) will consist of experts with wide-ranging backgrounds, including government departments, water research institutes, environmental health institutes, universities, water companies and a European trade association. The role of the major partners on the Management Committee will be to ensure that the main objective and specific objectives (see Section B) are achieved.

A further important feature is the discretionary formation of national clusters by each national representative. Such clusters (not funded by the Action) can be formed as best suits each participating country and will greatly enhance the Action's ability to disseminate its activities and to establish the most appropriate collaborative research partnerships.

The structure also offers an opportunity for the working groups to be supported by the most relevant expert from each participating country (not necessarily the national representative).

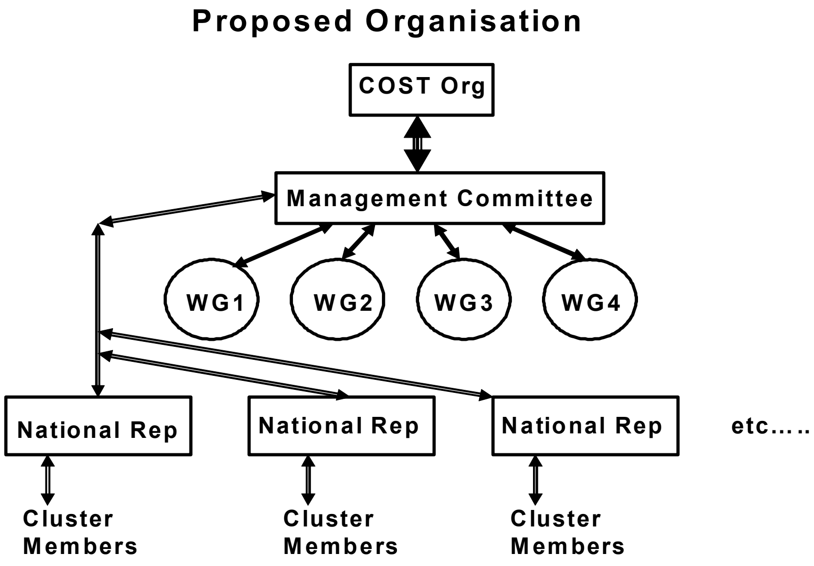


Figure 1. The organisational structure of the Action.

Working groups will have clear terms of reference with agreed milestones and will be accountable to the Management Committee. In general terms, each working group will follow the model programme outlined in Table 1.

The organisation of the Action readily accommodates additional membership.

The risk of the Action failing to deliver its objectives will be minimised by the large number of participating partners and the formation of numerous national clusters.

The liaison arrangements of the Action will extend to the European Commission's DG Environment, DG Research (and its relevant research programmes) and the Technology Platform on Water, ENDWARE (the drinking water regulators' forum), EUREAU (the European water suppliers' association), TECHNEAU (the EU's integrated research programme) and the USA's Environmental Protection Agency.

F. TIMETABLE

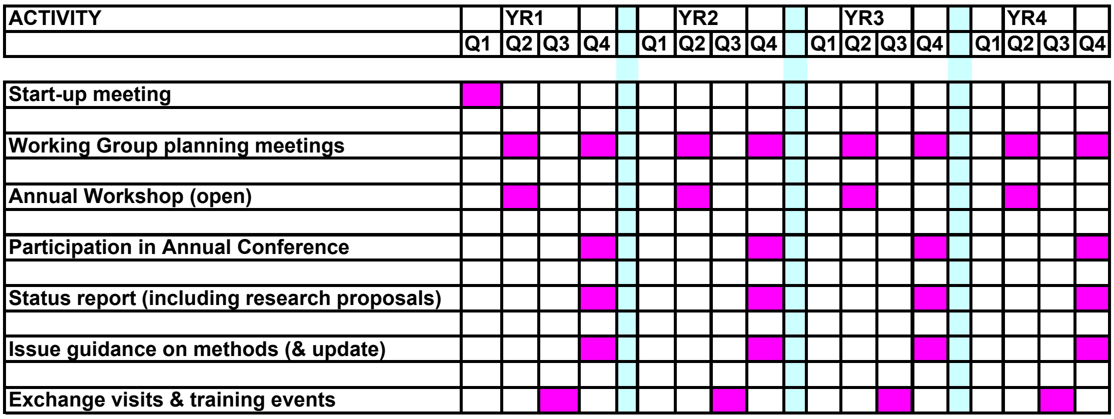
The COST Action will cover a four-year period. A model programme for a working group is shown in Table 1 and will be integrated with meetings of the Management Committee (a start-up meeting, then six-monthly thereafter):

Particularly in the first year, the Management Committee will also focus on the broadening of the Action to include further member countries and will provide encouragement to the setting up of national clusters, with support in the form of guidance for their operation and on-going liaison with the Action.

An intermediate report on the progress of the Action will be provided by the Management Committee to the COST Administration at the end of Year 2 and a final report will be provided at the end of Year 4.

Table 1. Timetable of the Action

Model programme for a COST Action Working Group



G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or have otherwise indicated their interest:

Austria, Cyprus, Czech Republic, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, United Kingdom.

On the basis of national estimates provided by the representatives of these countries, the economic dimension of the activities to be carried out under the Action has been estimated, in 2005 prices, at approximately 50 million EUR.

This estimate is valid on the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

The potential beneficiaries of the Action cover European-level policy makers, government policy makers, research institutes and academia, water supply authorities and companies, health authorities and (ultimately) water consumers.

The activities of the Action (workshops, conferences, etc.) and the reports produced by the Action (once agreed by the relevant parties) will be posted on a web site accessible to the general public. These activities and related news items will be circulated in an associated electronic newsletter (quarterly). The web site will also have password-protected areas for internal dialogue and management purposes.

Each working group will convene an annual workshop which will be open to all interested parties. Workshops will both stimulate and consolidate the detailed work of the working groups. Also on an annual basis will be an international conference on the topic of metals and related substances in drinking water. The conferences will determine their programme by both the selection of invited contributions and by advertising for contributions world-wide, thereby ensuring both balance and currency.

Working groups will be encouraged to publicise their work in articles in scientific and technical journals, to provide non-technical summaries for drawing attention to their work, and to actively support a series of workshops and conferences. State-of-the-art reports, case study reports and good practice guidelines will be prepared when appropriate.

The Management Committee will evaluate the performance of all dissemination activities at each meeting and adjust the dissemination strategy in the light of experience. It will produce an interim report and a final report to the COST Administration.