dwi

Research News

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Welcome to DWI Research News

The objective of our evidence programme is to provide the science base for policy on drinking water quality. There are many drivers for our programme, including the provisions of the European Drinking Water Directive (DWD), and the new Euratom Directive.

There are currently no plans to change the standards in the DWD though the provisions relating to monitoring, and analysis are under review. The Euratom Directive includes a new monitoring standard for radon in drinking water.

The programme also continues to include work to support the approval process for chemicals and products in contact with drinking water and projects aimed at better understanding the best practice in drinking water regulation, emerging issues, and rapid methods of analysis in the event of a threat to drinking water quality.

Further details can be found in our evidence plan which is published at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/221072/pb13914-evidenceplan-drinking-water-quality.pdf

Our open competitions will be advertised on the Defra E-tendering website, where you can register your interest.

Recently published DWI research

Monitoring of Nitrogenated DBPs in drinking water

The aim of this study, undertaken by Imperial Consultants, was to increase our knowledge of NDBPs in drinking water. The main driver was the DWD requirement to minimise disinfection by-product (DBP) formation. The project monitored selected NDBPs in drinking water at high risk sites and compared the concentrations found with established toxicological values, where available, or concentrations found in other countries.

A sampling survey of 20 water supply systems in England and Wales was conducted to measure the concentrations of N-DBPs in drinking waters. Water supply systems were selected to include treatment works that have suspected risk factors for the formation of N-DBPs and several supply systems with no risk factors to give a representative indication of typical N-DBP concentrations. The measured N-DBP groups were selected haloacetonitriles (HANs), haloacetamides (HAcAms), halonitromethanes (HNMs), and cyanogen chloride

Samples were collected from the pre-disinfection and final treated water stages at the treatment works as well as three locations in the distribution networks.

The findings showed that the N-DBPs occurred at broadly similar concentrations as have been reported in surveys in other countries. All the measured levels of dichloroacetonitrile and dibromoacetonitrile were below the current World Health Organisation (WHO) guideline values of 20 µg/l and 70 µg/l respectively.

The lowland water sources that were included in this survey formed more N-DBPs than the upland and groundwater sources. The six treatment works that applied ozone were associated with higher concentrations of HANs and HAcAms than non-ozone treatment works. This observation is potentially confounded because all the ozone works were treating lowland source waters which may have had higher N-DBP formation potential. The ozonated systems also produced higher cyanogen chloride concentrations, which agreed with the previous understanding of the formation of this compound. In general, supply systems applying chlorine

DWI, Area 7E, 9 Millbank, c/o Nobel House, 17 Smith Square, London SW1P 3JR
Tel: 0300 068 6406 email: judith.bibaud@defra.gsi.gov.uk

formed slightly more HANs and HAcAms than those applying chloramines.

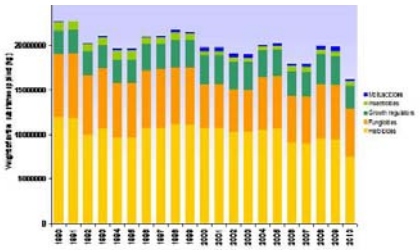
None of the N-DBPs exhibited consistent correlations with total THMs. Total organic carbon alone was not a consistent predictor of N-DBP concentrations nor were there clear observed links with other individual measured water quality parameters. Possible correlations with total organic nitrogen could not be investigated because of limitations in the sensitivity of the organic nitrogen measurement methods that were used.

There were no significant consistent differences between the N-DBP concentrations measured in the different sampling rounds, nor were there consistent trends between N-DBP concentrations and water age in distribution (distance from the treatment works).

The study provides further reassurance that the level of N-DBPs found in drinking water in England and Wales are broadly similar to those found in other countries and below any health based values available. The full report is available at: http://dwi.gov.uk/research/completed-research/reports/DWI70_2_268.pdf (1.73MB)

Understanding the changes in pesticide usage to inform water company risk assessments

In accordance with the DWD, water company monitoring of drinking water and raw water for pesticides is risk based. Understanding the changes in pesticide usage will help inform water companies risk assessments. This study undertaken by ADAS examined how European and national regulatory changes might impact future pesticide usage and consequently on water monitoring strategies.



Pesticide usage by weight and type

The study looked at trends in pesticide usage, reviewed legislative changes and their potential impacts, developed a series of scenarios to estimate the possible range of impacts of recent and future regulatory changes might have on pesticide usage, and assessed the likely removal of pesticides by existing drinking water treatment processes.

The study concluded that there is a great deal of uncertainty over the withdrawal of pesticide active substance from the market. Across the seven scenarios investigated through modelling there was a range of results from a small decrease in potential risk to a small to moderate increase in potential risk. However, for most there was little or no change in potential risk. Water treatment like GAC further moderates any increased potential risk with almost all compounds having at least a high probability of being removed by GAC.

The study provided a summary of recent changes in pesticide usage and estimated potential impact of future changes. Overall, the potential risks of drinking water breaches are estimated to be small under the possible future changes. The report will be of value to water companies in their current and future risk assessments.

A full copy of the report and its appendices can be downloaded from our website at: http://dwi.defra.gov.uk/research/completed-research/2000todate.htm#rachem

Health-based targets for drinking water safety and regulation

In collaboration with the Drinking Water Inspectorate (DWI), the Water Institute at UNC carried out a research project with the purpose of describing the relative health burden of drinking water system failures to better inform drinking water safety and policy. This project fits with our programme objective to understand best practice in drinking water regulation

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The research consisted of three main components: literature collection, database development, and statistical analysis. The systematic review gathered and collated all accessible drinking water disease outbreak (DWDO) literature worldwide published before Sept 2011 into the database. The formulaic review process gathered hundreds of individual outbreak reports and narrative (selective) reviews, which themselves merited further analysis to garner additional sources and their data.

The database contained information from 1,565 reported drinking water disease outbreaks. Around 72% of these outbreaks occurred in the U.S. Bacterial agents were listed as the primary microbial agent in 42% of outbreaks.
Attack rate data (the percentage of the number of cases divided by the number of people exposed) was analysed for catchment, treatment, and distribution-deficiency outbreaks. The means of those data, for the catchment, treatment, and distribution-deficiency outbreaks, were 31.9%, 25.9% and 21.2%, respectively. While this indicates a potential difference in the descending "severity" of the three types of DWDO causal factors in that order, the only statistically significant difference is between the means of the catchment and distribution-induced outbreaks. This must be qualified by the bias arising from frequent underestimation of the attack rate for the latter events (due to probable overestimation of the exposed population in the localised event).

These findings draw needed attention to the underlying trends in worldwide DWDO surveillance, distribution and health impact. The full report is available at: http://dwi.defra.gov.uk/research/completed-research/reports/DWI70-2-264.pdf (PDF 193KB)

Probabilistic modelling for assessment of exposure via drinking water

This project undertaken for us by Cranfield University was to develop and explore the potential benefits of probabilistic approaches to exposure assessment to chemicals by ingestion of tap water in England and Wales. Again this project fits within the objective of understanding best practice in drinking water regulation.


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Several approaches to probabilistic modelling were reviewed to assess their suitability for this purpose. Studies on intakes of tap water by the population were reviewed. Results of the studies were analysed and probability distributions were fitted to the water intake data for each study using maximum likelihood estimation. Data on the concentrations of chemicals in drinking water was available from compliance data collected by the water companies and supplied to the DWI.

The best method to provide the results required from the available data was assessed to be Monte-Carlo simulation.

The results of the simulations have shown that exposure to metals in tap water is highly variable. The 99.9th percentile exposure can be up to 45 times the mean and 200 times the median. For simpler exposure assessments, substitution by either the LoD or LoD/2 would probably give acceptable accuracy.

Exposure to iron, lead, selenium and manganese predicted by the simulations appear to have decreased by about 40% between 2004 and 2010 due to falling concentrations in tap water. For lead this is part of a long term trend, having previously decreased by 40% between 1994 and 2004. In contrast, the exposure to sodium appears to have increased slightly.

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The predicted exposures for the parameters studied were compared with Reference Nutrient Intakes (for required nutrients) and Acceptable Daily Intakes (ADI) or other recommended maximum intakes. For adults the 99.9th percentile exposures were less and generally much less than the RNI, the ADI or similar upper limit.

For children under 16, for most parameters studied, the 99.9th percentile of predicted exposure was much less than the ADI or other recommended maximum intake. For lead, similar extreme exposures for the lightest groups of children exceeded the ADI or the BMDL01. (Benchmark dose limit (BMDL): a statistical lower confidence limit on the dose or concentration at the BMDL01 is this limit at the 1% response level). The mean exposures were less than these measures for all weight groups of children. Similar methods could be applied to other substances found in tap water, such as trihalomethanes (by-products of chlorination). There are significant routes of exposure other than ingestion for these chemicals, notably skin contact and inhalation when bathing. A more complex model would therefore need to be constructed to adequately represent exposure to these substances.

The study provides interesting examples of how exposure via drinking water varies across the population as a whole. Exposure to many of the substances studied has declined as drinking water quality has improved and generally even extreme exposure estimates are below health based standards. For lead, extreme estimates for some groups of children may be high. This reinforces the existing DWI advice to flush tap where lead pipes are present. The full report is available at: http://dwi.defra.gov.uk/research/completed-research/reports/DWI70-2-273.pdf (PDF 4.49MB)

Potential contaminants in drinking water treatment chemicals

A recent study commissioned by the Inspectorate found that an unexpected contaminant was present in a ferric coagulant (which conformed to the appropriate BS:EN standard). DWI took a number of steps in response to the findings.

One of these steps was to investigate whether unexpected contaminants could occur in other treatment chemicals. The project supports the DWI's role in the approval process for substances in contact with drinking water. The study, by WRc, investigated the manufacturing process of water treatment chemicals and made an assessment of whether any unexpected contaminants were likely to arise at concentrations that would give rise to aesthetic or toxicological concerns for the water supply. The study also reported on incidents of post production contamination arising from storage or handling of the chemicals.

The findings confirmed that manufacturers incorporate appropriate quality assurance and quality control procedures to ensure the quality of their products. Few incidents of product contamination were reported to the authors.

Water Companies also have detailed procedures in place to avoid contamination of chemicals on delivery and storage. Few incidents of product contamination arising in this way were reported to the authors.

Manufacturers and water company processes/procedures have ensured that contamination of water supplies as a result of chemical contamination are rare occurrences. It is not possible to predict the presence of unexpected contaminants in treatment chemicals given current assessment processes but alternative approaches are suggested as to how such potential contaminants may be predicted.

The full report can be reviewed at: http://dwi.defra.gov.uk/research/completed-research/reports/DWI70-2-272.pdf (PDF 1.55MB)

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