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INTERNATIONAL CENTRE FOR ENVIRONMENTAL AND INDUSTRIAL TOXICOLOGY (ICEIT)

CRI's ICEIT has been designated as a
"UNEP Centre of Excellence for Environmental and Industrial Toxicology".

His Majesty King Bhumibol Presides at the Opening of the Fourth Princess Chulabhorn International Science Congress: Chemicals in the 21st Century

On 28 November 1999, His Majesty King Bhumibol Adulyadej presided at the opening of this congress dedicated to the celebration of His Majesty's 72nd birthday and to His Majesty's work and tireless endeavour to ensure that science is used to bring benefits to the quality of life of the Thai people.

Accordingly, Her Royal Highness Princess Chulabhorn, President of the Chulabhorn Research Institute, delivering the report of the congress stated:

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His Majesty King Bhumibol Presides at the Opening of the Fourth Princess Chulabhorn International Science Congress: Chemicals in the 21st Century

(Continued from page 1)

"This Congress itself has been organised to commemorate the auspicious occasion of Your Majesty's Sixth Cycle Birthday Anniversary. So, on behalf of the Thai people, who are Your loyal and devoted subjects, may I most humbly pay a sincere tribute to Your Majesty for the numerous untold beneficial acts that You have graciously performed for us all throughout your reign.

This Congress, the fourth in the series of Princess Chulabhorn Congresses, is being held on the topic *Chemicals in the 21st Century*, with the theme *of Chemicals for Sustainable Development*. This theme has been chosen because of Your Majesty's strong interest in the relationship between science, the environment and sustainable development for many years. Indeed, Your Majesty's Royal Initiated Development Projects for the health and happiness of the Thai people, are firmly based upon the principles of sustainable development."

With the theme of Chemicals for Sustainable Development, the Congress recognised both the positive and the negative impacts of chemicals on the environment and on people's lives.

In her paper **"Chemicals for Sustainable Development"** delivered on the first day to the Congress, Her Royal Highness Princess Chulabhorn expressed the current concerns as follows:

"To a large measure, almost all the positive associations of the word "chemical" have now been lost under a barrage of bad publicity, and it is difficult to shake off the negative implications of the term. Phrases like *"chemical disaster"* and *"chemical warfare"* only serve to accentuate this poor image.

Yet we have to consider "chemicals" in all their aspects. The usefulness of chemicals for human development surmounts other negative impacts, or should do if appropriate measures are taken to reduce risk and ensure safe use."

The scientific program of the Congress, linking the key areas of health, environment and technology, attracted 1,000 participants from countries throughout the world and provided a forum for experts and practitioners including those who develop, use and control chemicals, across a whole range of specializations.

As a highlight of the opening ceremony of the Congress, the keynote lecture "Global Smog" was delivered by the Nobel laureate Professor F. Sherwood Rowland of the Department of Chemistry, University of California, Irvine. The lecture emphasized that the increase in automotive traffic in most large cities causes substantial formation of ozone, and as the number of affected cities increases, the elevated ozone levels become more than an urban problem, crossing broad regions, and even spreading through whole latitudinal zones.

The four-day Congress program comprised 4 special lectures, 6 plenary lectures, 12 full symposia, 4 mini symposia, as well as 3 satellite workshops organized by International Organization for Chemical Sciences in Development (IOCD), Society of Environmental Toxicology and Chemistry (SETAC), and International Centre for Environmental and Industrial Toxicology (ICEIT).

There were 250 poster presentations that displayed research work being carried out in some 40 countries throughout the world. Some of the research featured in the poster presentations is described on pages 4 and 5.

At the closing ceremony of the Congress a lecture was delivered by Dr. Nay Htun of the United Nations Development Programme on "Chemicals and Human Development in the Twenty-First Century".

This was followed by the presentation of the Princess Chulabhorn Gold Medal Award to Professor Paul M. Newberne. This presentation is featured on page 3.

THE PRINCESS CHULABHORN GOLD MEDAL AWARD

This prestigious award was instituted by HRH Princess Chulabhorn in recognition of the importance of cooperation between scientists and between research institutes throughout the world. Such cooperation is essential to ensure that the results of research in science and technology are not only of the highest standards and useful to individual groups of scientists, but that they will also be of value to the worldwide scientific and technological community and used for the benefit of all mankind.

Thus the Princess Chulabhorn Gold Medal Award was instituted to honor and acclaim individual scientists or organizations of world renown who have in their work provided outstanding support for the activities of the Chulabhorn Research Institute and its main goal to utilize science for the improvement of quality of life. Past recipients of the Gold Medal have been Dr. Nay Htun, UN Assistant Secretary General; Dr. Frederick Becker, Scientific Director of the University of Texas M.D. Anderson Cancer Center; and Dr. Ronald Shank, Director of the Environmental Toxicology Graduate Training Program, Department of Community and Environment.

This year the recipient of the Princess Chulabhorn Gold Medal was Professor Paul M. Newberne, Professor Emeritus in Nutritional Pathology at the Massachusetts Institute of Technology and Professor Emeritus in Pathology and Toxicology at the School of Medicine, Boston University. Professor Newberne re-ceived the Gold Medal Award from Her Royal Highness Princess Chulabhorn at the closing ceremony of the Fourth Princess Chulabhorn International Science Congress on 2 December 1999.

During his most distinguished academic career, Professor Newberne has developed a range of research interests with a main focus on the pathology and biochemistry of diseases of nutritional origin, particularly of the liver and gastrointestinal tract, and nutritional carcinogenesis. This has led to research into food safety evaluation, nutritional toxicology and immunology, environmental toxicology and drug nutrient interactions. Professor New-berne's main teaching interests have been in the field of nutritional pathology, comparative pathology, drug safety, toxicology, and food-borne di-seases.

There can be few academics today, in any area of specialization, who are as successful as Professor Newberne in maintaining a balance and just proportion between such prestigious professional and international activities and cutting edge research.

Professor Newberne's list of academic publications is impressive by any standards. He has authored and co-authored over 300 refereed journal articles in addition to editing and co-editing seven standard reference and course books including Vol. 2 of the handbook Trace Substances and Health.

Other accolades and awards won by Professor Newberne during the course of his outstanding career include the National Cancer Institute Research Career Award, the FEMA award for his contribution to the livestock and poultry industry, the Border Award of the National Institutes of Health, and the award of Medal of the American Vetenary Medical Association.

Professor Newberne was a pioneer of the establishment of the scientific study of toxi-cology as a discipline in Thailand. In the 1960s he assisted in the establishment of the Faculty of Science at Mahidol University and he also served an initial term on the International Advisory Board of the Chulabhorn Research Institute. Thus from the beginning, Professor Newberne has contributed to the Institute's Environmental and Industrial Toxicology Program, helping through his wide experience to forge a practical and realizable design.

Poster presentatio
Princess Chulabh
Science

REMOVAL OF ARSENIC BY FRESHWATER ALGAE

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Ron Phibun district is located in Nakorn Si Thammarat province in the south of Thailand. Arsenic pollution occurs in this area because of the bad management of mine tailings. Surface waters were collected for the determination of algal species in both summer and the rainy season. Even though total biomass of algae growing in the surface water in summer are more than in the rainy season, the types of algae are similar. Altogether there are 15 algal species found. Out of these, only 3 species could be isolated as pure cultures; all three were unicellular, planktonic species. These algae were tested for their tolerance to arsenic by culturing them in solutions of various arsenate (0-500 mg As/ml) and arsenite (0-50 mg As/ml) concentrations. The algae which was the most tolerant species surviving 500 mg As/ml arsenate and 50 mg As/ml arsenite, was identified as *Chlorella sp.* Bioconcentration factors were directly correlated to the concentration of arsenic in the culture media. This research shows the potential of algae in removal of arsenic from water.

One of the general indicators used in evaluating the success of a scientific congress is the quality of the poster presentations and the degree of interest (measured in terms of attendance) shown by congress participants. Judged by this criteria, the Fourth Princess Chulabhorn International Science Congress was an outstanding success. Throughout the entire period that the posters were on display in the two rooms allocated for this purpose, participants thronged to read the display panels and to ask questions to the presenters. The two hundred and fifty poster displays represented a wide range of research, attracting the attention of all the congress participants. The research projects thus presented reflected, for the most part, the relationship between chemicals and health in areas throughout the world. Indeed the international coverage of research into chemicals and environmental health issues was an outstanding feature to the displays. Among the local presentations from Thailand was a research project currently being undertaken by researchers from the Department of Biology, Faculty of Science, Chiangmai University, into contamination of lead in algae in the Mae-Kha canal; research by the Faculty of Science, Mahidol University, Bangkok and the Chulabhorn Research Institute into the acute effect of acrylonitrile on motor behaviour activity in short-term nicotine-pretreated rats; research by the Chemical Research Institute of the Rajamangala Institute of Technology and the Royal Thai Irrigation Department into recycling community wastewater treatment by using bacteria media and pipe aeration; and a joint research project being carried out by researchers from the Department of Biology, Faculty of Science, Mahidol University, the Institute of Biology, Odense University, Denmark, and the Department of Botany, Chulalongkorn University, Bangkok, into the removal of arsenic from polluted waterways by freshwater algae.

Research into the impacts of chemicals on the environment currently being carried out in other countries in Southeast Asia was also well represented in the displays. Notable was a project on removal of heavy metals from sludge of industrial wastewater treatment plants in Vietnam; research into applications of technology for SO_2 emission control in Vietnam being carried out at the Hanoi University of Civil Engineering; information on the Philippine experience of industrial chemical management, presented by the Environmental Quality Division of the Environmental Management Bureau, Manila; the application of sensory tests for survey on polluted air in metropolitan areas, research being jointly undertaken by the Prefectural University of Kumamoto, Japan, and the Environment Management Center, Bapedal, Indonesia; and research into application techniques of innoculum and extended aeration to treat Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and suspended solids in latex effluent conducted by researchers from the School of Industrial Technology, University Science Malaysia.

ons at The Fourth horn International Congress

Perhaps most importantly, however, in an International Science Congress such as the Fourth Princess Chulabhorn International Science Congress, research projects carried out by institutes and universities in countries in the developing world were given equal prominence to display of research being done in institutions in the more developed countries. Research into the safe use of pesticides was reported from the Tropical Pesticides Research Institute, Arusha, Tanzania; metal ions concentration in the Okavango Delta, Botswana, a joint research study being undertaken by researchers from the Department of Chemistry, University of Botswana and the Department of Analytical Chemistry, University of Lund, Sweden; a presentation on pesticide poisoning in Nepal by the National Forensic Science Laboratory, Nepal; and a research project on pesticides in fish and fishery products in Lake Victoria by research workers from the Government Analytical Laboratory, Kampala, Uganda.

The main categories for poster presentations at the Congress were:

Food and Natural Products

Environmental/Industrial Chemicals

Pesticides

Airborne and Particulate Matter

Metals

Mixtures

USING AQUATIC MACROPHYTES TO CLEAN HEAVY METALS IN HANOI LAKE

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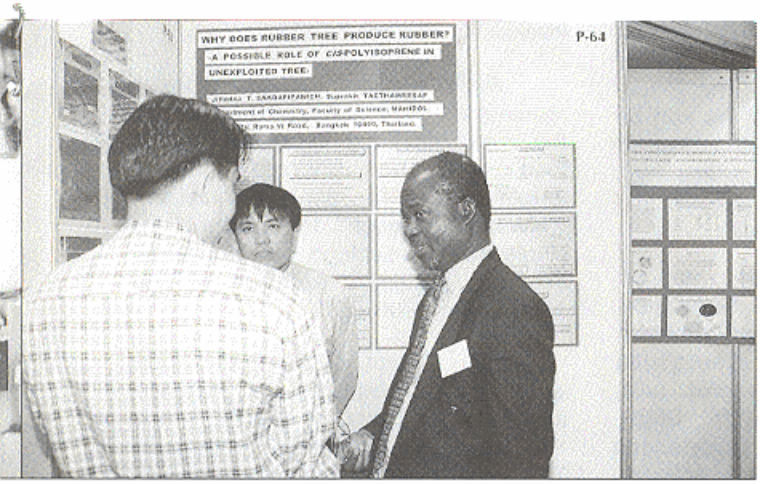
Baymau lake in Lenin Park is the second largest lake of Hanoi City, having an area of 21.6 ha with two pretty islands, makes a distinctive landscape for the Capital. Baymau lake not only plays the role as an important position for touriste-sport activities, regulation of the rain and aquiculture, but also is a considerable place of wastewater treatment for some sewage basins in the South City.

Nowadays, there are about 12,000 m^3/day domestic and industrial water discharged directly into the lake. That makes lake water in heavily polluted state. Research, evaluation of existing polluted water and proposal of treatment measures are being considered as an important task. In addition, biological treatment method has advantages such as low cost, high effect of treatment and without toxicity of environment.

In this paper two aquatic macrophytes have been used, namely, *Lemna minor* and *Ceratophyllum demersum* to clean water in Baymau lake.

Research results show some important conclusions as follows:

- *Lemna minor and Ceratophyllum demersum* have ability reducing concentration of some pollutants, especially, heavy metals such as Cu, Zu, Pb, Fe.
- Treatment effect of *Ceratophyllum demersum* is highter than *Lemna minor*.



Anticarcinogens/Cancer Chemopreventive Agents

Endocrine Disruptors

Dispositions and Biotransformations

Carcinogenesis

Biological Markers

Methods for Detection/Monitoring of Chemicals

Screening and Testing Strategies/Models

Molecular and Cellular Mechanisms of Action/Toxicity

Clean-up of Hazardous Waste and Remediation

Chemical Remediation

Bioremediation

Treatment of Toxic Chemicals/Industrial Wastes

Regulatory Policy

Safety Evaluation and Risk Assessment

Exposure to PCBs and Levels of Thyroid Hormones in Children

A recent study on potential exposure to a toxic waste incinerator in Germany tested the hypothesis that blood concentrations of polychlorinated biphenyls (PCBs) are predictors of thyroid hormone status in children.

Thyroid hormones are necessary for the development of brain function and cell growth; because of this, appropriate levels of peripheral thyroxine and triiodothyronine (T_3) are especially important in childhood. Deficiency of thyroid hormones can subsequently result in a serious delay in neurologic development.

Exposure to PCBs is suspected of altering the pituitary thyroid feedback regulation through various mechanisms.

Researchers in the German study investigated whether blood concentrations of PCBs, lead and cadmium, as well as concentration of mercury in 24-hr urine samples were associated with thyroid hormone status. As an indication of status, levels of thyroid-stimulating hormone (TSH), free thyroxine (FT_4) and free triiodothyronine (FT_3) were determined in children in households where approximately 10 cigarettes were smoked per day. Eight PCB congeners were measured in whole blood samples of which seven and the sum of all PCB congeners were analyzed as predictors for thyroid hormone status in separate linear regression models adjusted for potential confounders. In addition, the possible effects of lead, cadmium and mercury on levels of thyroid hormones were examined.

Blood concentrations and information on questionnaire data were available for 320 children aged between 1 and 10 years. A statistically significant positive association was found between the mono-ortho congener PCB 118 and TSH as well as statistically significant negative relationships of PCBs 138, 153, 180, 183 and 187 to FT_3.

There was no association for the PBC congeners and FT_4. Blood cadmium concentration was associated with increasing TSH and diminishing FT_4. Blood lead and urine concentration of mercury were of no importance to thyroid hormone levels. The results underline the need for future studies on the possible influences of PCB and cadmium exposure on thyroid hormones, particularly in children. These studies should also take neurologic development into account.

Source: Environmental Health Perspectives Vol. 107, No. 10 October 1999.

A New Treatment For Dioxin Poisoning

It has been found that olestra, a fat substitute designed for slimmers, can speed up the removal of dioxins and PCBs from the body.

This treatment was tested on two women patients admitted to hospital with chloracne, a symptom of dioxin poisoning. One had the highest blood level of 2,3,7,8 – tetrachlorodibenzo-*p*-dioxin (TCDD) ever recorded.

Fecal excretion of TCDD had previously been shown to be enhanced by a factor of 4 to 7 in volunteers by the consumption of chips containing olestra. Based on this report, the two patients were given olestra chips over 38 days using five different dosing regimens lasting 7 days each. The patients experienced no gastrointestinal side effects.

When they consumed up to 90 g of the chips a day, olestra increased the rate at which the women excreted dioxin in their feces by a factor of 8 to 10. The cloracne was found to improve in one of the women, but not in the patient who was most severely poisoned.

Source: The Lancet Vol. 354 October 9, 1999.

Monitoring of Occupational Exposure to Inorganic Arsenic

A study of glass-workers in Italy was undertaken to assess reliable biological indicators for monitoring occupational exposure to inorganic arsenic (iAs) allowing for the possible confounding role of arsenicals present in food and drinking water.

When assessing occupational exposure to iAs by biological monitoring, it is necessary to consider the biotransformation pathway of the element itself.

In the human body, iAs changes in oxidation state in both directions: pentavalent species can be found in the urine after a dose of the trivalent As and it has been shown that subjects who ingested meals rich in pentavalent As excreted mainly the trivalent species in urine. The reduction capacity of pentavalent As can be very efficient but results in increased toxicity: indeed, trivalent As has high affinity for thiol groups of proteins and molecules such as lipoic acid.

Biotransformation of arsenic, however, involves mainly methylation, leading to the formation and excretion of monomethylated and dimethylated compounds (monomethylarsonic acid, MMA; dimethylarsinic acid, DMA). Experimental and human observations suggest that two enzymatic activities with a different reaction rate are involved in this methylation.

Arsenobetaine (AsB) which represents, with tetramethylarsonium, the most important species of As in food does not undergo biotransformation and is almost completely eliminated through the urine: one single meal of seafood can induce, for example, a urinary excretion of total As of up to 1000 µg/l.

The absorption of As from food, water, and air explains the presence, in variable amounts, of the element in the urine of the general population. The urinary concentrations of As vary

INCREASED RISK OF CHILDHOOD LEUKEMIA AND PRECONCEPTIONAL PATERNAL EXPOSURE TO PESTICIDES

A study carried out in Canada has linked paternal exposure to pesticides to acute lymphoblastic leukemia (ALL) in children. The study recorded preconceptual paternal occupational exposure to pesticides and to fertilizers that are generally mixed with them. The numbers were too small to estimate risks according to levels of exposure, the categories of which were pesticides, fungicides, insecticides, herbicides, and fertilizers.

The study showed that childhood leukemia risks were increased with all categories of exposures, in particular with fungicides and with fertilizers. Most of the fathers in the study had been exposed to more than one category of contaminant under study.

The underlying mechanisms cannot be elucidated from the findings of the present study. However, it seems possible that genomic imprinting may be involved in cancer predisposition and that this imprinting leads to the silencing of a gene in a parent-specific manner. It is crucial in human embryogenesis in which the paternal genome is indispensable for placental function and embryonic development.

This occurrence is relevant for understanding the development of cancer that involves a complex interplay of endogenous and exogenous factors leading to an imbalance in gene expression. The most attractive mechanism for abnormal imprinting in cancer is the alteration of DNA methylation.

The researchers propose the possibility that exposure to chemical and physical agents could modulate the methylation state and consequently the activity of paternally derived alleles.

Thus cancer in young children might be regarded as one of the outcomes resulting from male-mediated developmental toxicity.

Source: The Lancet Vol. 354 November 20, 1999.

considerably, between 5 and 50 µg/l, and therefore groups from different countries could be distinguished on this basis. The urinary As, for example is much higher in Japan and the United States than in European countries, where it varies.

In occupationally exposed subjects, the urinary excretion of As metabolites varies in accordance to the dose absorbed from the working environment but may also be influenced by other sources among which food and water can play an important part.

After several years of biological monitoring of occupational exposure to As the measurement of some urinary species of the element (iAs itself, MMA, and DMA) has been suggested. The basic argument for justifying this choice is that these urinary As species are not influenced by the presence of organoarsenicals of dietary origin.

The correlation between As in ambient air and urinary As in exposed workers has been studied in several surveys with As as biological indicator, usually the sum of these species of As. This correlation varied considerably, due to different working exposures investigated, different air sampling methods, and different analytical methods adopted both for environmental and biological samples and to the possible confounding role of some methylated forms of dietary origin as recently emphasised.

In the study, 51 glass workers exposed to As trioxide were monitored by measuring dust in the breathing zone, with personal air samplers.

Urine samples at the end of work shift were analysed for biological monitoring. A control group of 39 subjects not exposed to As, and eight volunteers who drank water containing about 45 µg/l iAs for a week were also considered. Plasma mass spectrometry (ICP-MS) was used for the analysis of total As in air and urine samples, whereas the urinary As species (trivalent, As^3; pentavalent, As^5; monomethyl arsonic acid, MMA; dimethyl arsinic acid, DMA; arsenobetaine, AsB) were measured by liquid chromatography coupled with plasma mass spectrometry (HPLC-MS).

The results showed environmental concentrations of As in air varied widely (mean 84 µg/m, SD 61, median 40) and also the sum of urinary iAs MMA and DMA, varied among the groups of exposed subjects (mean 106 µg/l, SD 84, median 65). AsB was the most excreted species (34% of total AS) followed by DMA (28%), MMA (26%), and As^3+As^5 (12%). In the volunteers who drank As in the water, the excretion of MMA and DMA increased (from a median of 0.5 to 5 µg/day of MMA and from 4 to 13 µg/day for DMA). The best correlations between As in air and its urinary species were found for total iAs and As^3+As^5.

To avoid the effect of As from sources other than occupation on urinary species of the element, in particular on DMA, it is proposed that urinary As^3+As^5 may be an indicator for monitoring the exposure to iAs. For concentrations of 10 µg/m³ the current environmental limit for iAs, the limit for urinary As^3+As^5 was calculated to be around 5 µg/l, even if the wide variation of values needs critical evaluation and application of data. The choice of this indicator might be relevant also from a toxicological point of view. Trivalent arsenic is in fact the most active species and its measure in urine could be the best indicator of some critical effects of the element, such as cancer.

Source: Occupational Envrionmental Medicine No. 12 December 1999.

Chemical Legislation in the European Union

In the 1960s, the national laws of countries which now form the European Union differed widely and this created barriers to free trade. A framework for new comprehensive legislation, known as the "dangerous substances directive" (DSD) was drawn up in 1967. This outlined procedures for classification, labelling and packaging of dangerous substances.

Later, in 1988, the European Union introduced the "dangerous preparations directive" (DPD) to replace existing national laws and provide a standard for industrial and domestic users of chemicals across Europe.

The DPD sets out requirements for classification, labelling and packaging of formulated products. As with dangerous substances, suppliers of "dangerous" preparations must provide industrial users with a safety data sheet (SDS). Physicochemical hazards such as flammability, explosivity and oxidising properties can be determined either by testing the preparation or by "common sense": if none of the component substances has these hazardous properties, then the preparation clearly cannot either.

Health hazards of preparations are calculated using formulae given in the DPD. Each "dangerous" property (for example, toxicity by inhalation or ingestion, eye or skin irritancy, or corrosivity) is evaluated separately, taking into account all the component substances with that particular property and their relative proportions in the preparation. "Weighting" parameters for substances are given in the DPD or in Annex I of the DSD. The calculation can be modified if necessary to allow for any synergistic or antagonistic effects.

If toxicology tests are carried out on the preparation, the results will take precedence over those obtained using the DPD calculation method. And whether calculation or testing is used to classify the preparation, if experience in use shows the effects on humans to be different, then these are used instead.

Under the scheme, suppliers can test preparations for general toxicological properties. But they cannot test for specific health effects, such as carginogenicity, mutagenicity and toxicity for reproduction, since these are considered to be properties of the component substances that will be unaffected by the substance being formulated into a preparation.

In recent years, it was recognised that the DPD needed updating and improving, in particular to include environmental hazards. The original directive had no environmental classification and labelling criteria for preparations: the only obligation was to include known environmental effects of component substances in the SDS for the preparation. Final arrangements were agreed earlier this year, and the updated DPD was published in July 1999.

As with assessment of health hazards, the intention is that most preparations will be evaluated for environmental effects by a calculation method based on the properties of the components and their relative proportions in the formulation. The new DPD sets out a calculation scheme, along with values for "weighting" parameters. For the scheme to operate fully, specific parameter values will have to be given for classified substances in Annex I of the DSD.

Preparations can also in principle be tested for ecotoxic effects in aquatic organisms. As with assessment of human health hazards, the results of tests would take precedence over those obtained using calculations based on the properties of the component substances. However, such test results can only supersede calculated results for ecotoxicity studies. The other key properties in assessing environmental hazards – persistence in the aquatic environment and bioaccumulation potential – are considered to be properties of individual substances and to be unaffected by formulation into a preparation.

Another change in the DPD is an animal welfare initiative. Under the updated directive, no new animal studies can be done on a preparation unless the supplier can demonstrate that the particular health hazard cannot be evaluated satisfactorily by calculation or using existing animal studies on the preparation. The third major change introduced in the new DPD is that from 2004 it will be extended to cover plant protection products, such as herbicides for agricultural and domestic use, which are currently classified and labelled under a different scheme.

Source: Chemistry & Industry 18 October 1999.

The ICEIT NEWSLETTER is published quarterly by the International Centre for Environmental and Industrial Toxicology of the Chulabhorn Research Institute. It is intended to be a source of information to create awareness of the problems caused by chemicals. However, the contents and views expressed in this newsletter do not necessarily represent the policies of ICEIT.

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