CRI/ICEIT
NEWSLETTER

VOL. 2 NO. 1 – JANUARY 1992
ISSN 0858-2793
BANGKOK, THAILAND

Chulabhorn Research Institute

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".

Expertise Required in Developing Countries to Manage Toxic Wastes

Scientists and academics from around the world took part in the training course. Sitting (from left) are D. Calamari, D.J. Ecobichon, F. de la Iglesia, P.M. Newberne, HRH Princess Chulabhorn, M. Ruchirawat, J.H. Duffus, J.F. Borzelleca and H. Schroder. The back row are R. Becker, C. Visvanathan, R.C. Shank, B.E. Bengtsson, Y.H. Zhuang, L. Reutergardh and J. Verink.

Developing countries need more experts to help cope with the adverse effects of chemicals on human health and the environment.

This point was stressed by Her Royal Highness Princess Chulabhorn in an address at the opening of the "International Training Course on Environmental and Industrial Toxicology" on 18 November 1991. Focused on pollution control and assessment, the course provided training to 60 government officials and academics from 11 Asian-Pacific countries.

Advances in science and technology, she said, have introduced many chemicals that have become an essential part of every aspect of daily life. As countries undergo modernisation, industries discharge more chemical wastes that eventually harm human health and the environment.

"Virtually every chemical can be toxic depending on dose, condition and duration of exposure, as well as various host factors," she said.

The four-week training course was organised by the International Centre for Environmental and Industrial Toxicology of Chulabhorn Research Institute (CRI), in collaboration with the Asian Institute of Technology, with financial support from the United Nations Development Programme, to assist developing countries in human resources development.

As part of CRI's education and training activities under its International Programme on Environmental and Industrial Toxicology, the training course aimed at integrating the fundamental principles of toxicology and engineering practices to foster a multidisciplinary approach for the safe use of chemicals in development.

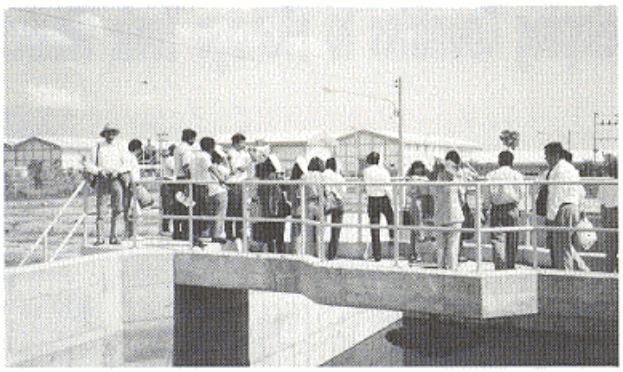
Prevention and management of toxic

(Continued on page 8)

TRAINEES VISIT WATER TREATMENT PLANTS IN EASTERN SEABOARD

The International Training Course on Environment and Industrial Toxicology: Pollution Control and Assessment was organised by the Chulabhorn Research Institute, in collaboration with the Asian Institute of Technology, on 18 November-12 December 1991. The training course successfully integrated the fundamental principles of toxicology with those of engineering to foster a multidisciplinary approach to the safe use of chemicals in development. Such a combination has never been attempted before.

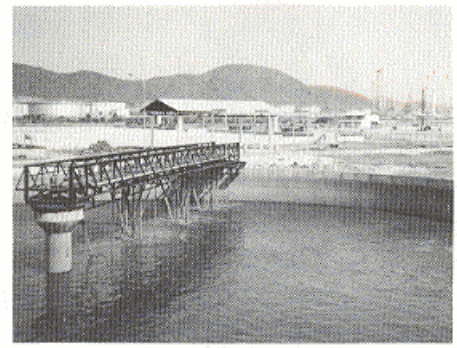
On 5-7 December 1991, a group of participants attending the training course took a three-day field trip to three wastewater treatment plants at the Eastern Seaboard Industrial Estate.



The Map Ta Phut's wastewater treatment plant uses the surface aerator to provide oxygen for the suspended bacteria to biodegrade the polluted water.

First, they visited Pattaya's wastewater treatment plant. Using a secondary treatment process based on the rotating biological contactors (RBCs), the plant can treat wastewater up to 8,000 cubic metres a day.

The next stop was at a treatment plant in Rayong's Map Ta Phut Industrial Estate. Wastewater released by industries is neutralised before being treated in an activated sludge unit. The plant's surface aerator provides oxygen for the suspended bacteria to biodegrade the organic wastewater. The treatment effluent is chlorinated before being discharged into the nearby canal.



The Laem Chabang Industrial Estate's wastewater treatment plant.

On the same day, the group also visited a wastewater stabilization pond at the Petroleum Authority of Thailand's gas separation plant.

On 7 December, the group was taken to see another wastewater treatment plant at the Laem Chabang Industrial Estate. The plant also employs the RBCs method similar to that of Map Ta Phut.

DIOXIN MAY NOT BE AS HARMFUL AFTER ALL

Dioxin, or better known as Agent Orange, may be less dangerous than previously believed, says an article in ***Science*** *(Vol. 251, 8 February 1991), reviewing the latest debate involving the chemical. At the heart of the debate is a new scientific idea, still inconclusive at this stage, on assessing the danger of dioxin to humans. If there is any merit to the idea, the United States Environmental Protection Agency (EPA) could be forced to change its way of gauging the risk.*

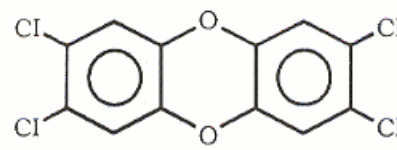
Recently, a group of scientists concluded that dioxin at low level exposures posed no risk of cancer or any other effects on human health. This conclusion was arrived at using a new model to predict dioxin's risk based on a molecular understanding of how the chemical works.

According to this theory, dioxin must first bind to and activate a receptor before it can become toxic. No toxic effect can occur until the receptor is activated and transported to the cell nucleus, where it interacts with the DNA to cause damage. There is a minimum dose of dioxin for binding to the receptor, and if the receptor is not activated, there can be no toxic effect. This view directly challenges the way in which EPA measures dioxin's potency.

"If the receptor binding is indeed the essential first step before any toxic effects can occur...then this implies there is a 'safe' dose or practical 'threshold' below which no toxic effects occur," the article says. "And that, in turn, means that the model EPA uses is wrong."

Scientists have been trying to determine just how dangerous dioxin really is ever since it was first detected in the late 1950s as a by-product of herbicide manufacture. Animal studies have shown it to be exquisitely lethal, the most potent carcinogen ever-tested. But its effects on humans have been difficult to pin down.

The EPA currently employs a linear risk assessment model based on an assumption that there is no safe level of dioxin in humans and that the toxic effects rise proportionately with dose. The model sets a stringent acceptable intake level at 0.006 picogrammes per kilogramme of body weighter day. The receptor-based approach, on the other hand, puts the "safe" level several hundred times higher at 1 to 3 picogrammes per kilogramme per day. More importantly, this model, the proponents say, is applicable to other carcinogens that work through receptors.



2,3,7,8-Tetrachlorodibenzodioxin

However, not all of the 38 scientists, who attended the conference at the Banbury Centre at Cold Spring Harbour Laboratory, U.S.A., agreed with this line of thinking. Those who disagreed with the new approach charged that the con-

(Continued on page 3)

US Industry Emits Less Toxic Waste

United States industry is becoming cleaner but not to the extent the Environmental Protection Agency (EPA) believes it to be.

EPA's Toxics Release Inventory has reported that there was an 18 per cent decrease in industrial toxic waste emissions between 1987 and 1989. This figure is being challenged because, according to an article in *Chemistry & Industry* (3 June 1991), "much of the large improvement could result from exaggerated estimates made in 1987".

Taking stock of 22, 650 U.S. industrial plants, the data showed a total release of 5700 million pound of toxic chemicals in 1989, representing a cut of 1300 million pound over 1987. According to EPA, toxic waste emissions to water dropped 54 per cent; landfill dumping declined by 39 per cent; and air releases — 42 per cent of all emissions — fell by 8 per cent.

The Agency will reassess its data and results are expected to be made public in late 1991.

SWISS FIRM ACCUSED OF DUMPING DDT IN TANZANIA

Ciba-Geigy, a Swiss chemical-manufacturing giant, has been accused of illegally exporting to Tanzania a DDT pesticide that has long been banned from use because of its toxicity.

Accoridng to an article in *Chemistry & Industry* (3 June 1991), a company spokeman said that the firm had not violated the law when it secured a contract to supply Ultracide combi to Tanzania. But it was never in the company's policy to export the highly toxic product. Though it was legal to use the product on cotton in Tanzania, the company nevertheless offered to buy back the pesticide's entire stock "for proper disposal".

Ultracide combi contains a mixture of DDT (35 per cent), organophosphorus insecticide (15 per cent) and methidathion. Its use was made illegal by the European Community (EC) in the late 1970s.

"DDT exports are still permitted, although a draft EC directive requires 'prior informed consent'," the article said.

The World Health Organization has estimated that every year up to 25 million people in developing countries suffer from occupational pesticide poisoning.

NEW CHEMICAL METHOD TO TREAT NITRATE-CONTAMINATED WATER

An American scientist has found a new way of removing nitrate from water reports *Chemistry & Industry* (1 April 1991). By adding powdered aluminium into the nitrate-contaminated water, the chemical reacts with nitrate turning the latter to ammonia.

Until this new discovery by Andrew Murphy of the United States Bureau of Reclamation, biological methods have been used for nitrate destruction.

A high concentration of nitrate in groundwater poses health hazard and threatens the environment.

Murphy says the ammonia could be extracted from the water to produce chloramines, which "can prolong the stability of residual disinfectant during distribution and can eliminate certain organic by-products resulting from chlorination."

The chemical method works best under specific alkaline conditions, at pH 9.1-9.3.

clusion that dioxin was far less risky than the EPA's estimate was premature and purely speculative. For example, Ellen Silbergeld, a toxicologist formerly with the Environmental Defense Fund and now at the University of Maryland, cautioned against "replacing one stupid model with another," contending that the receptor-binding theory did not imply a "safe" dose.

"And even if the new model does indicate that EPA's risk number is far too conservative, revising it would be horrendously difficult...," the article explains.

A recent study, backed by the strongest evidence so far, showed dioxin to be a human carcinogen but only at exceedingly high doses. The study was based on the mortality records of all U.S. chemical workers (a total of 5172 men at 12 different plants) exposed to dioxin on the job from 1942 to 1984. In the low-exposure group, defined as those working less than one yearin a dioxin-contaminated job, there was no increased risk of cancer, even after exposure to dioxin levels estimated to be 90 times higher than that of the general population. By contrast, the high-exposure group, who received doses estimated to be 500 times higher than the general population, had an almost 50 per cent increased risk of death by cancer.

The study by no means implies that the assumption of the receptor-based approach is correct, the article says, but merely raises questions on the implications of low dose exposure to dioxin. Where does this leave the new model? The proponents of the new theory say there is no question in their mind about its validity, but the next step is to build a conceptual model to refine the risk for dioxin and then to measure the background exposure of the general population.

Is the Banbury group's reasoning convincing enough for the EPA to change its mind and adopt the new approach? It is unlikely, the article says, unless the group can prove the model's validity beyond doubt.

Although there is no indication that the EPA is about to change its standards for measuring risk levels of dioxin, it has not altogether turned a blind eye to the new model. In response to "new scientific evidence," the EPA management has promptly called for a re-evaluation of the risks of dioxin exposure.

"We cannot draw conclusions about the results of our assessment until a complete review has been performed," EPA chief executive William Reilly says, in *Chemical & Industry* (6 May 1991).

It will take one year before the review's results are known. In the meantime, EPA will continue to assume that dioxin is highly dangerous to human health.

'THAILAND HAS NOT HAD THE POLLUTION CATASTROPHY WHICH OTHER COUNTRIES HAVE EXPERIENCED'

Professor Ronald C. Shank is Director of the Graduate Programme in Environmental Toxicology, California College of Medicine University of California at Irvine. He is a member of the International Advisory Board of the Chulabhorn Research Institute (CRI).

Recently, he gave several lectures at the International Training Course on Environmental and Industrial Toxicology: Pollution Control and Assessment. The training course is a major activity of CRI.

Professor Shank shared his thoughts with us on some of the problems related to industrial toxic waste contamination in this part of the world, especially Thailand.

Q: Chemicals are being used more and more these days. What is the impact on the environment from the use of these toxic substances?

Professor Shank: Generally all over the world, the amount of contamination — pollution of the air, water and even food supply — is increasing because of more development and expanding population in each country. The major pollution problems deal with the use of pesticides. Factories use chemicals and dispose them into the air and into the ground. Also, the number of automobiles has increased, and this is causing more air pollution from automotive fuel combustion. As the population increases, energy use also increases. People burn more fuels, more wood, more coal and more gasoline, in order to provide for themselves, and this also produces more pollution. There are many sources of pollution, and most of them are well recognised and can be controlled. But that can be very expensive.

Q: The use of pesticides seems to have caused a big problem in most poor developing countries of the region. DDT, for example, is widely used because it is relatively cheap. Is it true that poorer countries have more problems? And why?

Professor Shank: Generally, that is true. It's for many reasons. Pesticides are poison by their nature. They are made specifically to be poison because they are made to kill insects or rodents or plants. These compounds must be used very carefully. One must be well-trained to learn how to use these compounds safely. Although they are sold in developing countries, not everybody there has had the education to know how to use them. If pesticides are used by the people who are not trained, they often times poison themselves or others. The problems are many fold.

People will buy a bottle of pesticide and use it, and then they don't know they have to wash the bottle. They should dispose of the bottle but don't. They save the bottle and use it for carrying drinking water or some other food products. They contaminate the food products and poison themselves and their family. They don't realise that the instructions on how to use the pesticide must be followed very carefully. A lot of people feel that if they use pesticide, the more they use the better it will be. They think they will kill more mosquitoes if they use a lot more, and even that's not necessary true. If they use the chemical more than they are supposed to, they often kill animals other than mosquitoes, including humans.

It's a very expensive process to control the use of pesticides. One must train people first and then monitor the importation, manufacture and distribution of these compounds, so you'll know where they're going and who is using them. This is an expensive process. You need to hire a lot of people; you need to have offices to keep all these records. The poor countries can't afford to do this, and there're still several countries that even if they have the money, don't know what to do. Not all of the countries participate in conferences or in training courses like this one. Some countries don't pay attention to what the United Nations is doing in controlling the use of pesticides and other chemical substances. In order to do it properly, they have to spend a fair amount of money to educate government and agricultural workers, and to set up a monitoring system to make sure people are using the chemicals properly.

Q: Isn't it true that the problem begins with the developed countries, which are producers of highly toxic substances that are banned in their countries? Somehow these chemicals are exported to developing countries. Why haven't developed countries stopped producing dangerous toxic chemicals and come up with safer products?

Professor Shank: That's very true. The problem begins with the developed countries, because they make the chemicals and sell them for exports. There is an attempt by the United Nations to make it more difficult for the developed countries to sell chemicals which are banned or severely restricted in their own countries. A case in point is DDT. The United States has banned the use of DDT for almost 20 years. There are companies in the United States, which still manufacture DDT and sell it for export. The companies will tell you that they manufacture this material as a service to those countries that suffer from malaria and that DDT should be used only for public health purposes, not for agricultural purposes. But in fact, they will sell it to most people who will buy it. It's very difficult to control this kind of product because the companies are in business to make money. If they can do it by selling effective but banned pesticides, they will do it assuming that the people who buy the pesticide know how to use it. In the case of DDT, the companies felt that the ban was an unnecessary restriction.

Q: How can we make the best use of chemicals without slowly killing ourselves?

Professor Shank: The best way to use chemicals is to understand what they can do to the people who use them directly and to the people who are exposed to those chemicals indirectly through pollution and contamination and through eating food that has been treated with the chemicals. The first step is education to train people so that they'll understand why chemicals are toxic and how people can control and prevent them from causing human disease. Essentially, every chemical is toxic; every chemical has a toxic level. The whole problem is dose and how much you are exposed to it. If you keep the exposure to the minimum and use only as much as you absolutely need, most chemicals can be used safely. It's very important to make sure that everybody who manufactures or uses chemicals understands what they can do to the environment and human health.

Q: To what extent is chemical pollution a problem in Thailand?

Professor Shank: Thailand is a leader in the Third World in carrying out problems to make people aware of the hazards posed by chemicals and in training people to understand what these chemicals do and how they can be controlled. There are still many problems in Thailand. Thailand is growing very fast. Its rapid development is causing a lot of environmental problems, including those from the use of pesticides. But it appears that Thailand is doing a great deal to control the use of chemical substances and to prevent the threat to human health and the environment. Still, it has a long way to go. I must say that for the tremendous amount of development that is taking place here, Thailand has not had the pollution catastrophy that other countries have experienced. You have been able to expand your economy rapidly without an enormous cost to the environment. There are problems such as air and water pollution in Bangkok. But these are old problems that can be solved.

Q: There are many highly toxic chemicals being sold here without any restriction. This will do more harm than good. What can we do to ensure their safe use?

Professor Shank: The government has the information on how to control these chemicals. That information has been presented at several conferences here in the past. Government representatives have attended many of these conferences to hear this information. It takes them some time to build the governmental infrastructure to put together a programme that will be able to survey, monitor and control pesticides that are coming into the country. It's my understanding that the concern is more on small manufacturers within Thailand making these pesticides rather than the multinational companies bringing them in. The multinational companies, I understand, do register their chemicals with the government. The problem seems to be that people are buying chemicals that are relatively safe, but they are either not aware of what they should do or for several reasons are unable to handle these compounds correctly. The problem can be addressed by setting up a more active monitoring system on the part of the government.

Q: Is Thailand short of manpower to deal with the problem?

Professor Shank: Yes. Thailand needs more people trained in, for example, environmental engineering, toxicology, industrial hygiene, and risk management and assessment.

Q: What is occupational cancer?

Professor Shank: Occupational cancer is a phrase we use to refer to people who get cancer because of the work they do. They have a job, a specific job, and in that job they are exposed to one or more chemicals that can cause cancer. If they didn't have that particular job, they wouldn't have gotten cancer. So we feel the cancer is caused by their occupation. There are many examples of this. We've talked about some in the training course here. One example is people who work with the gas vinyl chloride. Vinyl chloride is used to make PVC (polyvinyl chloride). It's well known that people who are exposed to a high level of vinyl chloride for several years will develop a serious cancer of the liver, which cannot be treated. That is an occupational cancer. They would not have gotten that cancer had it not been for the high exposures to vinyl chloride that they had in the job.

Q: Is it the workers' responsibility to learn how to protect themselves?

Professor Shank: The companies should take every precaution to ensure that the workers are exposed to safe levels of the compounds.

Q: As you know, companies are reluctant to adopt precautionary measures because this will mean added cost.

Professor Shank: But the cost of their employees getting cancer is very great. So the companies should be willing to spend the money to protect their workers.

Q: You said "should".

Professor Shank: Yes, should. It's up to the countries to decide if they want to enforce that kind of law.

Q: How do you see the situation in the future? Will it improve, despite the fact that Thailand, as in other countries, finds itself using more and more chemicals in the course of its development?

Professor Shank: I think the situation will improve. However, the main problem to improvement will be getting industry and government to cooperate. Industry has to realise that the government is trying to protect the country and the people without harming the economy and industry. The government has to realise that industry is very important to the economy. It's the driving force for the economy. Industry has to make a profit; that's the whole idea of industry. The government and industry have to work closely together. They can't fight each other. They have to help each other. With them working together, they can solve the problem of how to handle chemicals safely. Most of the technologies to handle chemicals are already here. It's just a matter of implementing those technologies to prevent chemical exposures.

I live in an area of California that is being developed. It used to be a farm land. The land is owned by a company. The company does not allow any industry into the area to build on that land, unless it complies with a series of environmental regulations. An industry that has a potential to pollute will not be allowed to buy the land in the first place. The company, which owns the land, has the rights to impose restrictions. I think the Thai Government should follow that model. Thailand is in an excellent position because the country is building new industries all the time. Now is the time to tell those industries that when they come in, they have to protect the environment and the health of the people. But there is one problem with that. If Thailand is the only country that imposes such measures, this will drive away foreign investors. They will invest in other countries where they don't have to spend money to protect the environment. So, all countries should get together and make, not just their country but the whole region, safe.

MANUFACTURED GASES CONTRIBUTE SIGNIFICANTLY TO GLOBAL WARMING

The term "Greenhouse Effect" was coined by a Swedish chemist, Svante Arrhenius, in 1896. Arrhenius theorised that the burning of fossil fuels would increase the amounts of carbon dioxide in the atmosphere, thereby leading to a warming of the planet. He calculated that if carbon dioxide concentrations in the atmosphere doubled, we could expect a 4.5 degreee Celsius temperature rise — a figure which is remarkably close to the predictions being made today.

For millions of years, this greenhouse effect has sustained life on this planet. In a greenhouse, the sun's rays enter and warm the interior, but are prevented by the glass from escaping back to the cooler air outside. Consequently, the temperature in a greenhouse is warmer than outside temperatures. Similarly, the greenhouse effect keeps our planet warmer than the bitterly cold temperatures of space. Tiny quantities of greenhouse gases in the atmosphere trap the sun's heat, warming land, air and water, and allowing life forms to flourish.

Thanks to the ability of greenhouse gases to trap the sun's heat, this heat remains in the lower atmosphere long enough to evaporate water from soil, vegetation, rivers, lakes and oceans, turning it into vapour which rises into the cool upper atmosphere to form clouds and rain.

Before industrialization, the greenhouse gases occurring naturally in the atmosphere absorbed just enough of the sun's heat to keep the world at an average temperature of about 15 degrees Celsius. Now, however, manufactured gases are trapping more and more of the sun's heat in the lower atmosphere, preventing it from escaping into space. As a result, global temperatures are forecast to rise by 2-5 degrees Celsius by 2100 — and to continue rising until we reduce our emissions of greenhouse gases to an extent where their atmospheric concentrations once more approach pre-industrial levels.

Each year, human activity is responsible for releasing 5.7 billion tons of carbon into the atmosphere, along with substantial volumes of other greenhouse gases such as chlorofluorocarbons, methane and nitrous oxide. Carbon dioxide is the major greenhouse gas, accounting for about 55 per cent of global warming. Four-fifths of all carbon dioxide emitted through human activity comes from burning fossil fuels — coal, oil and gas — and most of the remainder results from cutting down tropical forests.

Chlorofluorocarbons, used mainly in refrigeration, air conditioning, the manufacture of foams and insulation materials, and in aerosols, make the next largest contribution to global warming — around 24 per cent — while methane contributes a further 15 per cent and nitrous oxide accounts for 7 per cent.

Greenhouse gases remain in the atmosphere for decades and even centuries. Consequently, even if we stopped all emissions tomorrow, the planet would continue to warm, and the climate would keep changing, for at least a century.

The article is condensed from the *State of the World Environment, 1991: Report of the Executive Director,* United Nations Environment Programme.

DEVELOPING COUNTRIES NOT SERIOUS ENOUGH IN REDUCING USE OF CFCs

After carbon dioxide, chlorofluorocarbons (CFCs) make the next largest contribution to global warming. These chemicals also destroy the ozone layer, the atmospheric shield against solar ultraviolet radiation, thereby raising the risk of cancer and threatening food crops.

To limit their use and gradually replace them with CFC alternatives, governments adopted a protocol in 1987. The Montreal Protocol, which came into effect on 1 January 1989, imposes a 50-per cent reduction in the production and consumption of CFCs by 1998.

CFCs are used to manufacture refrigerants, solvents and plastic foams. Their use, mainly concentrated in industrially advanced nations, is rapidly increasing in developing countries.

The Montreal Protocol gives special considerations to developing countries with low CFC consumption by allowing them a ten-year grace period. Any developing country party to the Protocol, whose annual calculated level of consumption of CFCs is less than 0.3 kilogrammes per capita within ten years of the Protocol's entry into force, is entitled to delay its compliance with the control measures for production and consumption by ten years, in order to meet its basic domestic needs.

Leniency has created an undesirable effect. Instead of trying to reduce their consumption of CFCs, developing countries have become complacent about implementing the objectives of the Montreal Protocol. They are not trying hard enough to do away with CFCs, says Sherif Arif, an environmental specialist for the World Bank, in *Chemistry & Industry* (1 April 1991).

There seems to be "a certain lack of urgency," says Arif, who forecast that developing countries' dependency on CFCs "could actually increase by the year 2000".

"Developing countries have not adequately weighed the full impact of the Montreal Protocol," he says.

What seems to be lacking in these countries is clear policy and technical expertise. Local industry relies heavily on its foreign partners and distributors for technical help and information.

Arif says Third World governments should be prepared to eventually phase out CFCs. Training is needed to develop a core of skilled personnel, and local research institutions need support to pursue their own solutions.

Meanwhile, the race is on to find alternatives to CFCs, chemical substances that have little or no impact on the environment. So far a series of hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) have been introduced to replace CFCs. Although these alternatives are not altogether risk-free to the environment, they represent the best that industry has to offer at this time.

According to a news report of a study conducted by Professor Takeshi Tominaga of Tokyo University, HCFCs and HFCs provide only temporarily relief until the "third generation" of CFC substitutes — a chemical that will not deplete the ozone layer and will damage the environment as little as possible — are developed.

HCFCs both destroy ozone and act as a greenhouse gas. But they have

(Continued on page 7)

THAILAND REDUCES CONSUMPTION OF CFCs

Thailand has reduced its consumption of ozone-depleting substances (ODS), according to a report of the Ministry of Industry.

National short-term policies, such as import restrictions and tax incentives, to discourage industries from using ODS have been successful, it said.

The government has adopted a long-term plan to gradually phase out and replace ozone-depleting chlorofluorocarbons (CFCs) with safer products.

CFCs destroy the ozone layer, thus leaving the earth exposed to ultraviolet radiation from the sun. This poses an increased risk of skin cancers and eye cataracts for hundreds of thousands of people, and also endangers crop production in large parts of the globe.

CFC-11, CFC-12 and CFC-113 are among the most widely used ODS in Thailand (see Table 1).

The report was presented at a workshop on the Implementation of the Montreal Protocol for the Protection of the Ozone Layer, held in Jomtien on 26-29 November 1991.

Organised by the United Nations Environment Programme, the workshop was part of the Multilateral Fund's global programme to provide resources for developing countries to reduce ODS consumption. The Fund was established by the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, with a budget of US$200 million for an interim three-year period, starting in January 1991.

Thailand is a contracting party to both the 1985 Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol.

The report said the Kingdom's growth rate in the consumption of CFCs was among the highest in the world. From 1986 to 1989, the use of the chemicals increased by as much as 98 per cent, from 2,520 to 5,035 tons, and by 46.5 per cent to 7,350 tons in 1990, from the previous year (see Table 2).

The growth rate of ODS consumption has been estimated to decrease by 18.8 per cent in 1991. This more modest increase is due in part to governmental interventions and the private sector's efforts in helping to reduce ODS consumption.

Beginning in July 1991, the government has imposed import restrictions on CFCs. Firms must obtain permission from the government before they can import CFCs. The quantities of the imports must not exceed companies' production capacities

Industries seeking support from the government are discouraged from using ODS. Thus ODS-based industrial projects will not be granted privileges by the Board of Investment.

As an incentive, the government provides tariff reductions to encourage the import and installation of CFC-12 recovery and recycling equipment.

CFC-12, used mainly in automobile air-conditioning and refrigeration industries, comprises Thailand's largest ODS imports in 1991, followed by CFC-113 and CFC-11 (see Table 1). CFC-13 is consumed in the electronic industry and CFC-11 in foam blowing plants.

The decline in the growth of CFC-113 consumption was the result of electronic industries opting for safer alternatives. "Some firms have achieved a great reduction through just simple mechanic adjustment of the equipment and good housekeeping," the report said.

A new, safer compound has been developed as a substitute for CFC-12. "It can be expected that most of the new passenger cars marketed in Thailand will be using non-CFC refrigerant by 1994," it said.

As a long-term plan, Thailand has established a trilateral partnership with the Environmental Protection Agency of the United States and the Ministry of International Trade and Industry of Japan to promote the transfer of technology of non-ozone depleting materials for the benefit of Thai industry.

The government has also initiated a number of research studies, for example, on non-CFC solvents and on the recycling of CFCs.

Table 1. Thailand's Import of CFCs (1986-1991)

Substance	Weight in tons (in thousands)					
	1986	1987	1988	1989	1990	1991
Trichloromonofluoromethane (CFC-11)	500	266	313	1,070	1,521	1,964
Dichlorodifluoromethane (CFC-12)	1,000	1,860	2,180	1,925	2,727	3,495
1,1,2-Trichloro 1,2,2-trifluoroethane (CFC-113)	1,000	1,170	1,517	2,000	2,939	3,073
Dichlorotetrafluoroethane (CFC-114)	—	—	—	—	47	68
Monochloropentafluoroethane (CFC-115)	—	—	—	—	28	43
Total	2,500	3,296	4,010	4,995	7,261	8,642

Source: The Department of Industrial Works.

Table 2. Increasing rate of CFCs Consumption (Weight)

Year	CFCs (tons)	Increase from previous year	% increase
1991	8,759	1,389	18.8
1990	7,370	2,340	46.5
1989	5,030	1,000	24.8
1988	4,030	718	21.7
1987	3,312	792	31.4
1986	2,520	—	—

Source: The Department of Industrial Works.

a shorter lifespan than CFCs — up to 20 years against up to 100 for CFCs. They also pose risks to human health. HCFC-123, for example, has been found to cause benign tumours in the pancreas and testes of male rats.

Because HFCs contain no chlorine, they cause no damage to the ozone layer, but they contribute to global warming.

UNCED'S PREPCOM III DISCUSSES HAZARDOUS WASTE MANAGEMENT

The Preparatory Committee for the United Nations Conference on Environment and Development (UNCED) held its third session recently at Geneva, Switzerland. The meeting discussed, among other things, a United Nations report on Environmentally Sound Management of Hazardous Wastes.

In the report, waste minimisation, recycling and cleaner production methods were proposed as an option for hazardous waste management, to be incorporated into Agenda 21 of UNCED's action programme. UNCED is scheduled for 1-12 June 1992, at Rio de Janeiro, Brazil.

Here are some of the points made in the report:

- Waste minimisation has emerged as the top priority in the hierarchy of waste management options ranging from reduction at source, through recycling and reuse, to treatment and safe disposal. Waste minimisation involves technological and managerial changes and is part of a broader, preventive approach to environmental management, which includes pollution prevention and clean technology strategies.
- Until recently, attention was given to pollution control, which helped reduce contamination but regarded the generation of waste as peripheral to the production process. Corrective efforts in the past have focused on "end of pipe" control strategies, emphasising on, for example, scrubbers and filters. Also, regulations have tended to take a medium-specific approach to waste management, often resulting in the transfer of pollutants from one medium to another. Industry generally has taken a reactive approach, rarely moving beyond regulatory compliance.
- It has become clear now that this reactive approach is inefficient. A growing range of measures are being adopted by governments, industry and international organisations to promote a more cost-effective preventive approach to waste management.
- A number of methods can be used to minimise waste as well as other discharges including good housekeeping, organisational changes, substitution of materials, and production modification and reformation.
- Recycling and conversion of waste follow waste minimisation at the end of the processes or at the end of the pipeline. Classification of waste needs to begin at source and the aim must be to recycle or reuse waste, wherever feasible, and to keep to the minimum the amount of waste for final disposal. In addition, good manufacturing practice and promotion of cleaner technology play an important role for waste minimisation.
- The costs of hazardous waste management (treatment, storage and disposal) are high due to their intrinsic character. As more wastes are discharged, the costs of waste management become much higher.
- Based on the "polluter-pays principle", governments can exact a tax on the polluters to minimise the generation or disposal of hazardous wastes. Such taxes increase production costs and therefore lessen competitiveness. To avoid this problem, some countries keep their tax low.
- In developing countries, the tax is often set too low to affect effective waste management. At the same time, lack of enforcement encourages illegal waste disposal. Taxes are usually levied on the generation, transportation, storage and disposal of hazardous wastes. The revenues are used to improve treatment, transportation, storage and disposal facilities.
- Education and training are necessary for engineers, scientists, workers and others who frequently come into close contacts with chemicals, to ensure their safe use.
- There is a need for research to improve understanding of the nature of hazardous materials, to identify their potential environmental effects and to develop technology to safely handle them.
- Capacity building is needed to strengthen institutions and organisations, including government regulatory agencies, industries and universities.

EXPERTISE REQUIRED IN DEVELOPING COUNTRIES TO MANAGE TOXIC WASTES

(Continued from p.age 1)

waste is a problem of central importance to sustainable development, said Princess Chulabhorn, President of CRI.

"Pollution in terms of toxic and hazardous substances discharged by industry needs to be closely monitored to avoid contamination of the environment with toxic substances," she said. "There is, therefore, an imperative need for us to learn how to live with chemicals safely. This requires proper management strategies, increased public awareness, and suitably trained manpower in government, academic and private sectors."

Course lectures were provided by eminent scholars and scientists from Canada, Denmark, France, German, Italy, Japan, People's Republic of China, Sweden, Thailand, United Kingdom and United States.

The ICEIT NEWSLETTER is published quarterly by the International Centre for Environmental and Industrial Toxicology of the Chulabhorn Research Institute, supported in part by the Asian Development Bank. 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.

Correspondence should be addressed to:

ICEIT NEWSLETTER
Chulabhorn Research Institute
Office of Scientific Affairs
c/o Faculty of Science, Mahidol University
Rama 6 Road, Bangkok 10400, Thailand
Telex: 84770 UNIMAHI TH
Telefax: (662) 247-1222
Tel: (662) 247-1900