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The Conservation Foundation

ENVIRONMENTAL INFORMATION SERVICE

USAID Grant #DHR-1406-G-SS-6036-00

PROGRESS REPORT
APRIL 1, 1987 TO OCTOBER 31, 1987

Funding for the Environmental Information Service under USAID Grant #DHR-1406-G-SS-6036-00 terminates on October 31, 1987. This progress report, in combination with the progress report for August 1, 1986 to March 31, 1987, serves as a final report for that grant. As the attached financial report shows, USAID funding for this project was expended by late September. Since that time, The Conservation Foundation has funded the Service with its own resources. The Foundation will be able to continue to fund the Service through December, 1987; however, if commitments for additional funding are not secured by that time, the Service will have to cease operation.

Major Accomplishments

The Environmental Information Service responded to 31 information requests from ten countries between April 1 and October 31, 1987. In addition, ten responses are in the process of being completed as this report is being prepared. The subject of the responses ranged from soil erosion to industrial effluent treatment to hazardous waste disposal. One of the most recent responses, and possibly one of the most important, was the provision of information to OIKOS, a Brazilian NGO headed by congressman Fabio Feldman, on responding to radiation contamination which they are using in their efforts to address the recent contamination incident in Goiania. Complete listings of the responses prepared during this period, plus those in-progress which will be completed in early November, are attached as Appendices A and B. For seven of the responses we produced a Spanish language summary report.

In addition to responding to inquiries, the Service organized and participated in two short-term consultations, one each in Peru and Thailand. We are currently preparing for a third consultation to Ecuador which will occur from November 10 through 20 in Quito.

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As a result of a request for information on the proper disposal of wastes from a wood preservation treatment plant in Shiringamazu, Peru, the Environmental Information Service organized a team of experts to visit the plant and make recommendations. The team consisted of an environmental policy expert from The Conservation Foundation, a wood preservation expert from U.S. industry, and a hazardous waste disposal expert from the U.S. Environmental Protection Agency (USEPA). The team made several recommendations on the proper handling and disposal of chromated copper arsenic (CCA) while in Peru and, upon their return, prepared a report summarizing health and environmental information on CCA and recommended handling procedures. The report was prepared in both English and Spanish. A copy of the body of the report (in English) is attached as Appendix C.

As a result of several information responses to Thailand, the Service was asked to organize a team of two experts to spend three weeks, July 10-31, in Thailand working with the Thai National Environment Board to establish an environmental information center and assisting the USAID Mission in developing a comprehensive, seven-year program for addressing urban and industrial pollution problems in Thailand. The expert team, consisting of two environmental policy and information experts from The Conservation Foundation, Before leaving Thailand we briefed mission personnel on our proposals and, upon returning to the United States, prepared a final report. A copy of the Executive Summary of that report is attached as Appendix D.

For both of these consultations the Service provided staff time and the participating mission provided travel expenses. The time of the non-Service staff on the consultation in Peru was donated by their employers, USEPA and Koppers Company, Inc. While in both Peru and Thailand, Lane Krahl took the opportunity to meet with government officials and NGOs to inform them about the Environmental Information Service. Indeed, while in Peru, The Conservation Foundation used its own funds to pay for Mr. Krahl to visit Ilo and meet with a local NGO, Asociacion Cultural Labor-Ilo, which needed information on the health effects of air pollution from copper smelting.

Currently the Environmental Information Service is organizing a team of two environmental policy experts, one from the Foundation and the other from USEPA, to assist the Ecuadoran Direccion Nacional Hidrocarburos in the preparation of a benefit/cost analysis of reducing lead in gasoline. This consultation will occur on November 10-20, 1987. The development of this consultation is occurring under the Environmental Information Service; however, because the USAID mission in Quito does not have funds for this effort, the travel expenses will be funded directly by The Conservation Foundation. As with the consultation to Peru, USEPA is contributing its staff time to the Service.

Financial Report

The attached financial report is not a request for reimbursement, but is included only for your information. As it indicates, we have spent $139,313 to-date on the Environmental Information Service, $126,941 of which came from USAID. The remaining $12,372 was funded directly by The Conservation Foundation.

ENVIRONMENTAL INFORMATION SERVICE

FINANCIAL REPORT, AUGUST 1-OCTOBER 31, 1987 *

Item	Expenses-to-Date
Salaries	$ 45,629
Fringe Benefits	17,996
Consultant Fees	7,531
Conference & Meeting Expenses	4,928
Staff Expense - Local	74
Xerox	872
Postage and Shipping	1,113
Telephone and Telegraph	751
Research Materials & Publications	3,042
Miscellaneous	15
Indirect Costs	57,362
TOTAL	$139,313

* The expenses for October 1987 were estimated.

APPENDIX A

RESPONSES COMPLETED,
APRIL 1, 1987-OCTOBER 31, 1987

APPENDIX A

ENVIRONMENTAL INFORMATION SERVICE

RESPONSES COMPLETED APRIL 1, 1987-OCTOBER 31, 1987

INQUIRY RECEIVED: 03/03/87 RESPONSE SENT: 04/03/87

NAME: Guillermo Acevedo
AGENCY: CAR
COUNTRY: Colombia

SUBJECT: Impacts of soil erosion

INQUIRY RECEIVED: 02/26/87 RESPONSE SENT: 04/15/87

NAME: Margarita Astralaga
AGENCY: INDERENA
COUNTRY: Colombia

SUBJECT: Petroleum--control of pollution from exploration and extraction (Spanish)

INQUIRY RECEIVED: 03/11/87 RESPONSE SENT: 05/05/87

NAME: Mick Graig, Victor Gonzalez
AGENCY: Belize Audubon Society
COUNTRY: Belize
SUBJECT: Environmental Impact Assessment--how to prepare environmental impact assessments

INQUIRY RECEIVED: 04/21/87 RESPONSE SENT: 05/07/87

NAME: Molly Kux
AGENCY: USAID
COUNTRY: El Salvador

SUBJECT: Health effects of using asbestos cement roofing materials

INQUIRY RECEIVED: 03/23/87 RESPONSE SENT: 05/21/87

NAME: Howard Clark
AGENCY: USAID/Peru
COUNTRY: Peru

SUBJECT: Hazardous Wastes--handling and disposal of CCA used in wood preservation (Spanish)

INQUIRY RECEIVED: 03/03/87 RESPONSE SENT: 06/09/87

NAME: Camenza Robayo
AGENCY: CAR
COUNTRY: Colombia

SUBJECT: Water Quality Standards--background information

INQUIRY RECEIVED: 03/02/87 RESPONSE SENT: 06/09/87

NAME: Guillermo Echeverry Lopez
AGENCY: Ministerio de Salud
COUNTRY: Colombia

SUBJECT: Air Pollution, Mobile Source--background materials for emission standards on automobiles (Spanish)

INQUIRY RECEIVED: 04/30/87 RESPONSE SENT: 06/10/87

NAME: Richard S. Stevenson
AGENCY: USAID/Manila
COUNTRY: Philippines

SUBJECT: Materials on the presentation of environmental hazards (risks, impacts, etc.) to the general public. Focus on hazardous waste disposal

INQUIRY RECEIVED: 04/20/87 RESPONSE SENT: 06/11/87

NAME: Adelino Guillen Taboada
AGENCY: CETEC
COUNTRY: Brazil

SUBJECT: Environmental Impact Assessment of a large hydroelectric dam

INQUIRY RECEIVED: 02/23/87 RESPONSE SENT:06/11/87

NAME: Eduardo Figueroa
AGENCY: DIGEMA
COUNTRY: Ecuador

SUBJECT: Environmental Impact Assessment -- use of Delphi system

INQUIRY RECEIVED: 05/20/87 RESPONSE SENT: 06/27/87

NAME: Jorge de Lucio
AGENCY: APECO--Lima
COUNTRY: Peru

SUBJECT: Alternatives for sewage treatment for southern Lima and detergent pollution in lakes in NE Peru

INQUIRY RECEIVED: 03/03/87 RESPONSE SENT: 07/21/87

NAME: Camenza Robayo
AGENCY: CAR
COUNTRY: Colombia

SUBJECT: Sewage Treatment Plants--pricing policies

INQUIRY RECEIVED: 03/03/87 RESPONSE SENT: 07/21/87

NAME: Camenza Robayo
AGENCY: CAR
COUNTRY: Colombia

SUBJECT: Formulation of environmental impact statements

INQUIRY RECEIVED: 06/10/87 RESPONSE SENT: 08/17/87

NAME: Jorge Betancourt R.
AGENCY: Peace Corps
COUNTRY: Honduras

SUBJECT: EIS--methodologies

INQUIRY RECEIVED: 07/07/87 RESPONSE SENT: 08/19/87

NAME: Rosa Aquino de Vallejos
AGENCY: Instituto de Desarollo y Medio Ambiente
COUNTRY: Peru

SUBJECT: Pesticides--EPA background documents for organo-chlorides and organophosphates

INQUIRY RECEIVED: 07/10/87 RESPONSE SENT: 08/19/87

NAME: Jose Luis Lopez
AGENCY: Asociacion Cultural Labor-ILO
COUNTRY: Peru

SUBJECT: Health and environmental effects of sulfur dioxide

INQUIRY RECEIVED: 05/28/87 RESPONSE SENT: 08/20/87

NAME: Zilton Macedo
AGENCY: Emplaza
COUNTRY: Brazil

SUBJECT: Pricing electricity to cover costs and encourage conservation

INQUIRY RECEIVED: 02/20/87 RESPONSE SENT: 08/21/87

NAME: Eric R. Loken/Peter Bloom
AGENCY: USAID/Colombo
COUNTRY: Sri Lanka

SUBJECT: Uses of municipal and industrial wastewater

INQUIRY RECEIVED: 06/19/87 RESPONSE SENT:08/31/87

NAME: Ing. Eduardo Cacho
AGENCY: Ministerio de Energia y Minas
COUNTRY: Peru

SUBJECT: Petroleum -- pollution control during exploration and extraction (Spanish)

INQUIRY RECEIVED: 06/19/87 RESPONSE SENT: 08/31/87

NAME: Ing. Eduardo Cacho
AGENCY: Ministerio de Energia y Minas
COUNTRY: Peru

SUBJECT: Energy Law

INQUIRY RECEIVED: 06/20/87 RESPONSE SENT: 08/31/87

NAME: Juan Cueva Jaramillo
AGENCY: Comision Especial de Medio Ambiente
COUNTRY: Ecuador

SUBJECT: Omnibus environmental law

INQUIRY RECEIVED: 07/17/87 RESPONSE SENT: 09/02/87

NAME: Luiz Antonio Prado
AGENCY:
COUNTRY: Brazil

SUBJECT: Hazardous waste facility siting

INQUIRY RECEIVED: 05/25/87 RESPONSE SENT: 09/14/87

NAME: Alvaro Leonardo Diaz Souza Martins
AGENCY: Universidade Federal da Vicosa/Brazilian Senate
COUNTRY: Brazil

SUBJECT: Procedures for and evaluation of environmental impact statements

INQUIRY RECEIVED: 06/20/87 RESPONSE SENT: 09/16/87

NAME: Juan Moller-Hergt
AGENCY: APECO
COUNTRY: Peru

SUBJECT: Dangerous properties of industrial materials

INQUIRY RECEIVED: 08/17/87 RESPONSE SENT: 09/21/87

NAME: Dr. Mathuros Ruchirawat
AGENCY: Mahidol University
COUNTRY: Thailand

SUBJECT: Toxicity of tin in canned food

INQUIRY RECEIVED: 07/20/87 RESPONSE SENT: 09/23/87

NAME: Sr. Manuel Horra A.
AGENCY: Ministerio de Energia y Minas
COUNTRY: Ecuador

SUBJECT: Health effects of lead

INQUIRY RECEIVED: 02/26/87 RESPONSE SENT: 09/30/87

NAME: Margarita Astralaga
AGENCY: INDERENA
COUNTRY: Colombia

SUBJECT: Water Pollution, Industrial--treatment of waste streams from rum distilleries (Spanish)

INQUIRY RECEIVED: 03/24/87 RESPONSE SENT: 10/06/87

NAME: Bruce Kernan
AGENCY: USAID/Quito
COUNTRY: Ecuador

SUBJECT: Air Pollution, Stationary Source--health effects of and controls for emissions from asphalt mixing plants

INQUIRY RECEIVED: 03/03/87 RESPONSE SENT: 10/12/87

NAME: Camenza Robayo
AGENCY: CAR
COUNTRY: Colombia

SUBJECT: Sewage Treatment Plants--use of wastewater for irrigation

INQUIRY RECEIVED: 10/08/87 RESPONSE SENT: 10/15/87

NAME: Fabio Feldmann
AGENCY: OIKOS
COUNTRY: Brazil

SUBJECT: Environmental contamination from radiation accident

INQUIRY RECEIVED: 03/02/87 RESPONSE SENT: 10/31/87

NAME: Guillermo Echeverry Lopez
AGENCY: Ministerio de Salud Publica
COUNTRY: Colombia

SUBJECT: Pesticides--health and environmental effects of Glifosate, Triclopyr and Paraquat, herbicides used in the destruction of marijuana fields (Spanish)

APPENDIX B

RESPONSES IN PROGRESS,
NOVEMBER 1, 1987

APPENDIX B

ENVIRONMENTAL INFORMATION SERVICE

RESPONSES IN PROGRESS NOVEMBER 1, 1987

INQUIRY RECEIVED: 02/23/87

NAME: Eduardo Figueroa
AGENCY: DIGEMA
COUNTRY: Ecuador

SUBJECT: Petroleum--pollution control for transportation and refining (Spanish)

INQUIRY RECEIVED: 02/23/87

NAME: Eduardo Figueroa
AGENCY: DIGEMA
COUNTRY: Ecuador

SUBJECT: Mining--treatment and alternatives for the use of mercury in gold processing

INQUIRY RECEIVED: 02/23/87

NAME: Yolanda Kakabadse
AGENCY: Fundacion Natura
COUNTRY: Ecuador

SUBJECT: Petroleum--control of pollution from transportation and refining (Spanish)

INQUIRY RECEIVED: 02/26/87

NAME: Margarita Astralaga
AGENCY: INDERENA
COUNTRY: Colombia

SUBJECT: Petroleum--control of pollution from transportation and transfer from pipelines to ships (Spanish)

INQUIRY RECEIVED: 02/26/87

NAME: Margarita Astralaga
AGENCY: INDERENA
COUNTRY: Colombia

SUBJECT: Mining--treatment and alternatives to the use of mercury in gold processing

INQUIRY RECEIVED: 06/15/87

NAME: Galo Veintemilla
AGENCY: Accion Ecologica
COUNTRY: Ecuador

SUBJECT: Tear Gas--Information on environmental and health effects, cost, and production (Spanish)

INQUIRY RECEIVED: 06/19/87

NAME: Eduardo Cacho
AGENCY: Ministerio de Energia y Minas
COUNTRY: Peru

SUBJECT: Petroleum -- pollution control during transportation shore-to-ship transfer, and refining

INQUIRY RECEIVED: 08/17/87

NAME: Wicha Siwalai
AGENCY: Bangkok Municipal Administration
COUNTRY: Thailand

SUBJECT: Low-cost, innovative sewage treatment systems

INQUIRY RECEIVED: 01/29/87

NAME: Jorge de Lucio
AGENCY: APECO
COUNTRY: Peru

SUBJECT: Hazardous waste export

INQUIRY RECEIVED: 11/02/87

NAME: Carmenza Robayo
AGENCY: CAR
COUNTRY: Colombia

SUBJECT: Water Quality Modeling

APPENDIX C

FINAL REPORT ON THE FIELD VISIT TO
THE PRESCAP WOOD PRESERVATION PLANT
IN SHIRINGAMAZU, PERU, JUNE 21-26, 1987
(without appendices)

FINAL REPORT ON THE FIELD VISIT TO THE PRESCAP WOOD PRESERVATION PLANT IN SHIRINGAMAZU, PERU, JUNE 21-26, 1987

Prepared by:

Richard Brunker
Toxicologist
U. S. Environmental Protection Agency

Geoffrey Gill
Export Manager
Koppers Company, Inc.

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Associate
The Conservation Foundation

Prepared for:

U.S. AID Mission
Lima, Peru

August 21, 1987

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Appendix G: Sections from Standard Methods--Sampling Methods for Chromium, Copper and Arsenic

INTRODUCTION

An integral component of the Central Selva Resources Management Project in Peru is the treatment of poles and posts with Chromated Copper Arsenate (CCA). The proposed treatment process is a high pressure sap displacement system called Prescap. The USAID Mission in Lima asked The Conservation Foundation to gather information on environmentally sound handling and disposal of CCA and its waste products, organize a team of experts to review the Prescap facility in Shiringamazu, and prepare recommendations for the environmentally sound operation of the facility. The results of these efforts are presented in this paper.

On May 19, 1987 The Conservation Foundation presented its preliminary findings to the Mission in Environmental Considerations for the use of CCA in the Prescap Wood Preservation Plants of the Central Selva Resources Management Project. Subsequently, Lane Krahl, an Associate with the Foundation, led a team of experts on a visit to the Shiringamazu facility on June 21 through 26, 1987. The team consisted of Mr. Krahl, Richard Brunker, Ph.D., a toxicologist with the U.S. Environmental Protection Agency, and Geoffrey Gill from Koppers Company, Inc., a major producer and user of CCA for wood preservation. Mr. Krahl is an environmental policy analyst with over six years of experience in assessing domestic and international environmental programs. Dr. Brunker is an environmental toxicologist with 12 years of experience in assessing the health and environmental risks posed by the use and disposal of toxic chemicals including wood preservatives. Mr. Gill is the Export Manager for Koppers Company, Inc. and has over 20 years of experience in wood preservation in the United States and abroad.

This paper consists of five sections. The first four sections present general information on the viability of using CCA in a Prescap system, potential health and environmental hazards posed by the use of CCA, control measures to avoid contamination during handling of CCA solutions, and the disposal of CCA and its waste products. Much of the information presented in the May 1987 report is incorporated into these sections of the report. The final section presents the specific recommendations of the team of experts for the operation of the facility in Shiringamazu.

VIABILITY OF CCA IN THE PRESCAP PROCESS

The Prescap system is not currently in commercial use in the United States, however, during the 1970s a plant was operated in Avenger, Texas (Gjovik 1987). It has apparently been used commercially in Papua New Guinea and New Zealand; however, we have not been able to locate written materials on its effectiveness in these areas. The information on the viability of CCA in Prescap systems in this report comes primarily from

U.S. industry representatives who have heard of the system, but have no direct experience with it. These include personnel at the Osmos Wood Preserving Co., Inc. and Koppers Company, Inc. Lee Gjovik, at the U.S. Forest Products Laboratory in Madison, Wisconsin, however, has conducted some research at the Avenger plant and provided us with some of his information. A list of contacts made while collecting the information in this report is attached as Appendix A.

The industry representatives are concerned that the chromium (fixing agent) in the CCA will react prematurely with the sugars in the sap thereby fixing the copper (fungicide) and arsenate (insecticide) before full penetration is achieved and causing sludge buildup on the exterior of the wood. The extent of the problem will vary with each species because of variances in sap sugar content. An additional problem is sludging of the treatment solution and equipment as a result of recycling the sap to the treatment vats, a desirable practice for both economic and environmental reasons.

To avoid these problems, U.S. companies dry wood to below 30% moisture content before treatment with vacuum pressure impregnation. Unfortunately, this practice is not viable for Prescap which treats green wood.* In addition to drying wood below 30% moisture content, Koppers Company recommends in-line filtration of recycled solution and diluted work tank solutions to help prevent sludge build-up in the treatment solution and equipment.

These limitations of CCA are generally accepted for low pressure sap displacement and diffusion processes for which other chemicals have been developed. However, the only two articles we could locate on high pressure sap displacement processes (Hudson 1968 and Hudson and Shelton 1969) did not mention this problem and report successful treatment of southern yellow pine, red oak, red and black gum, and poplar with a CCA solution. Furthermore, Lee Gjovik did not encounter a sludging problem in his studies at the Avenger plant, nor did he find insufficient penetration in his investigation of preservative penetration behind knots in logs treated at the plant (Gjovik 1987).

Because of the paucity of information on the viability of using CCA in the Prescap system, effectiveness of the system for treating the species in the Palcazu River Valley should be high on the list of research priorities for the Central Selva Project and should precede further investment in Prescaps and CCA. Specific recommendations for the type of analyses which should be performed are presented in the Recommendations section of this report.

* Vacuum pressure impregnation was not originally thought possible in the Central Selva project; however, Appendix B presents a discussion of the use of this process and its possible application in the Central Selva project.

HEALTH AND ENVIRONMENTAL EFFECTS OF CCA

Chromated Copper Arsenate (CCA) is a highly effective wood preservative protecting wood against both rot and insect damage. When properly applied, the copper and arsenate precipitate and are fixed in the wood becoming highly leach resistant. The finished product is clean, oil-free and odorless and can be painted or stained. In addition to being a effective wood preservative, however, CCA is also a potentially dangerous chemical and is regulated in the U.S. by the Environmental Protection Agency (EPA).

HEALTH EFFECTS

In regulating the use of CCA, the EPA has focussed on the inorganic arsenicals. The EPA regulations are based on epidemiological studies of carcinogenic risks to copper smelter workers exposed to airborne arsenic and residents of a community in Taiwan exposed to arsenic in their drinking water (USEPA 1984). Industry scientists and some academics have disputed applicability of these studies to carcinogenic risks at wood preservative plants because of differences in the valence states of inorganic arsenicals in these different settings. Furthermore, because of concerns about the quality of the studies done in Taiwan, the Superfund Office at EPA recommended in November 1985 that risk assessments for arsenic should only use toxic effects (reference doses) which are significantly higher than the "allowable" doses derived using carcinogenic risks.

Chromium There are several reports concerning the effects of industrial exposures from hexavalent chromium (Cr^{6+}). The International Association of Research on Cancer (IARC) has taken the position that there is sufficient evidence that industrial exposures to chromium has caused lung cancer in workers (USEPA 1985). There are also animal studies that provide compelling evidence that hexavalent chromium can cause tumors from the inhalation of chromium dusts. The inhalation of particulates generated from sawing treated wood must be avoided (Friberg et al 1979).

Tannery workers exposed to hexavalent chromium (as chromic acid) have developed skin ulcers (USEPA 1985). There are also reports of acute irritative dermatitis and allergic dermatitis reactions from hexavalent chromium exposures. Skin contact with any solutions containing hexavalent chromium (such as CCA) should be avoided (Friberg et al 1979). There is no evidence, however, that the ingestion of chromium compounds has ever caused cancer in humans or laboratory animals but this may be due to insufficient test data. The EPA, therefore, does not consider chromium in the environment to constitute a cancer threat (USEPA 1984a).

Hexavalent chromium has also been demonstrated to be mutagenic (modifies DNA) in short term microorganism test systems

(USEPA 1984a). It is also clastogenic (it can break genes) in other tests employing bacteria as tested organisms. These tests suggest a cancer-causing capacity for this element.

Hexavalent chromium can also cause subchronic toxic impacts to those subjected to industrial inhalation exposures. These effects include ulcerated and perforated nasal septa (USEPA 1984a).

Arsenic Arsenic is a notorious systemic toxin that blocks specific metabolic reactions. It is highly toxic by both the inhalation and oral routes. Curiously, however, there is compelling evidence that it is an essential element in the nutritional requirements of vertebrates (USEPA 1985).

Although arsenic is classified as a known human carcinogen this classification is currently under review and considerable controversy. This classification resulted from an epidemiological study of the cause of an epidemic of skin cancer in Taiwan, but this study and its conclusions are currently being restudied. This is because numerous studies using laboratory animals subjected to high oral doses of arsenic over an extended interval of time have failed to elicit increased numbers of cancerous tumors. Also, many public water supplies contain relatively high levels of arsenic but studies indicate no increased cancers in the consuming communities. In any case, if ingested arsenic does cause cancer it only causes skin cancer (USEPA 1984a).

However, the inhalation of particulates containing arsenic has caused lung cancer in humans exposed in industrial settings. This exposure route has also been reported to cause birth defects in laboratory animals (USEPA 1985). Considering this possible threat from such particulates, care should be taken to protect individuals from any possible airborn particles from sawing treated wood.

There have also been reports of polyneuropathy (nerve damage) involving sensory and motor neurons from chronic occupational inhalation exposure to arsenic compounds. The extremities and myelinated long-axon neurons have been particularly affected. Contaminated foods have also been reported to cause these affects. The most common effects include numbness and tingling effects in the hands and feet as well as difficulties in making coordinated movements (Friberg et al 1979).

Copper There is no evidence that copper is particularly toxic or that it is carcinogenic to humans. It is, in fact, an essential element. Extremely high levels of copper in the diet can elicit toxic effects to humans, but such impacts are not a realistic exposure scenario at this facility. Such very high doses have been reported to cause vomiting, diarrhea, nausea, and gastritis eliminating this element from the affected person (Friberg et al 1979).

However, sheep are very susceptible to copper toxicity. The digestive tract is particularly vulnerable to copper. Effects include gastroenteritis, shock, and death (USEPA 1985). Such knowledge should provoke measures to preclude local sheep from access to contaminated bark from the process operation.

Solutions containing copper salts act as irritants producing an itching eczema. Conjunctivitis, ulceration, or turbidity of the cornea of the eyes can result from the accidental contact with copper solutions (USEPA 1984a). Appropriate eye protection is warranted in handling solutions such as CCA.

Human exposure Human exposure to CCA is of greatest concern at the processing plant particularly during mixing powder formulations, manual operation and maintenance of treatment equipment, handling freshly treated wood and chemical spills. There are not many studies of actual CCA wood preservation plant worker exposure to arsenic; however, a study done in California did find elevated arsenic levels in workers' urine (Rosenberg et al 1980).

Human exposure can also occur during the use of CCA-treated wood. Exposure can occur during sawing, drilling and nailing of treated wood, although proper ventilation appears to minimize these risks. Burning of CCA-treated wood releases arsenic and cases of acute reactions have been reported from such burning (Peters et al 1986). Finally, EPA prohibits direct contact of treated wood with food products and drinking water. EPA has determined, however, that the exposure to inorganic arsenic in houses built with CCA-treated wood is not significantly different from that in houses of untreated wood. EPA also allows the use of CCA-treated wood for constructing drinking troughs for domestic animals and livestock.

ENVIRONMENTAL CONSIDERATIONS

Chromium Chromium is known to be an essential element. It is accumulated by numerous aquatic and marine organisms. It can pass through the food chain from prey to predator or from plant to animal (USEPA 1985).

Practically all soil chromium is in the trivalent form which is only slightly toxic and relatively immobile. It is possible, however, but very unusual for chromium to be in the hexavalent form in soils. This situation requires highly oxidative conditions in the soil that it usually caused by the presence of high levels of manganese (Leeper 1978).

Conditions that affect the toxicity of chromium in aquatic ecosystems include water hardness, temperature, dissolved oxygen, age of affected individuals and the species impacted. Curiously, trivalent chromium is more toxic to fish than hexavalent chromium (USEPA 1985).

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Although some root systems of plants will accumulate chromium, none of the plants normally used as food by humans or animals will accumulate high levels of this element (USEPA 1985).

Arsenic If arsenic is released into the environment it can become mobile but this depends upon which of the oxidation states it attains. Under specific conditions in aquatic environments it can be methylated to form methylarsenicals or can be converted to arsine gas; both of which are volatile (USEPA 1985). The fact that it can be mobile and metabolized can cause arsenic to cycle through aquatic systems eventually reaching the deep ocean floors. Fish contain fairly high levels of arsenic (USEPA 1984a).

All inorganic states of arsenic have similar levels of toxicity to environmental receptors in aquatic systems. Vertebrates can metabolize moderate levels of inorganic arsenic in their livers. Because of this, arsenic does not bioaccumulate in these organisms and arsenic toxicity does not appear to incease with chronic exposure to low levels of this element (USEPA 1984a).

Poisoning by the ingestion of higher doses of arsenic is not particularly uncommon among domestic animals. Arsenic can cause edema of the digestive tract, pulmonary congestion, hemorrhage of the cardiac serosal surfaces, and liver cell damage. Local domestic animals, particularly ruminants, should be precluded from exposures to substances such as bark that may be contaminated with arsenic (CCA) (USEPA 1985).

Copper As previously mentioned, copper is very toxic to sheep by direct action on their digestive tract. It is also toxic to swine and somewhat less toxic to cattle (USEPA 1985).

This element will adversely impact a very wide range of aquatic organisms including algae, copepods, rooted aquatic plants, and fish. Very small amounts can effectively kill almost all of the higher forms of life in lakes and affected streams. Algae will bioaccumulate copper to a great extent. It also damages the gill surfaces of fish. However, bivalve mollusks such as oysters can bioaccumulate copper up to 28,000 times background levels with no evident adverse effects (USEPA 1985).

Copper has a strong propensity to bind to manganese oxides, clays, hydrous iron, carbonate minerals, and organic matter and, therefore, tends to be fairly immobile in aquatic ecosystems. Organic acids can mobilize copper but sorption processes and nutritional requirements within the biota limit the scope and extent of any releases (USEPA 1985). Levels of copper in solution, and therefore mobile, depend upon the chemistry of the water with ionic copper being more soluble in relatively acidic regimes.

Copper is accumulated by plants in soil regimes but is not generally biomagnified as it is an essential element and is readily utilized in metabolic processes (Leeper 1978).

The mobility of copper in soils is limited by its adsorption to organic matter, clays, sulfides, and other soil ligands although some copper compounds are soluble and, therefore mobile. In general, however, most soils will immobilize ionic copper spills of aqueous solutions (Leeper 1978).

Environmental Contamination Environmental contamination from CCA is most likely to occur from inadequate control of runoff from the treatment facility, uncontained drips from freshly treated wood, and improper disposal of wastes. Any of these situations could lead to contamination of surface waters and potential for fish kills. The potential also exists for contamination of ground water.

REDUCING EXPOSURE FROM PLANT OPERATION

As the title of this section states, the control of contamination is a matter of reducing exposure, not eliminating exposure. On the surface this difference may appear trivial, but the difference in the decision process under these two approaches is significant. If a society opts to eliminate contaminants it has assigned an infinite value to the absence of contaminants, i.e., elimination at any cost. The decision to reduce rather than eliminate contamination acknowledges the tradeoffs between the use and non-use of processes which produce contamination. The decision-makers must determine how much of a reduction is enough, i.e., what cost of reduction is acceptable. The point of this digression is to highlight that the information we can provide on process and disposal controls comes from EPA's determinations of risks and acceptable risks. The determination of acceptable risks for the Central Selva project could be quite different. For that reason we have included not only information on the requirements set by EPA, but also on the risk estimates they used to set the requirements and the risks associated with alternative control approaches.

EPA regulates CCA in the workplace under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). In January 1986 EPA promulgated rules governing the labeling of CCA which contain use restrictions (USEPA 1986). Excerpts from these rules pertaining to the use of CCA are attached to this report as Appendix C. EPA's rules are based on an assessment of carcinogenic risks from long-term (30 year) exposure to the inorganic arsenicals in the CCA. The risk estimates used in this assessment are conservative; that is, the true risks are not likely to be higher than the estimates but they could be considerably less. The risk estimates made by EPA are shown in Appendix D of this report.

EPA does not state a risk reduction goal for the regulation of arsenical wood preservatives, but an examination of the "acceptable" risks (i.e., those remaining after required protective measures are taken) indicates that they are generally geared to reducing risks below the one in a thousand probability range (less than 1 x 10exp-3) although for ambient air exposure 4.1 x 10exp-3 is considered "permissible".

Although these rules were written for plants using pressure cylinders, the basic control prescription is applicable to Prescap operations: avoid CCA contact with skin, eyes and mouth and minimize inhalation of dust.* Another general prescription offered by the industry is that employees be educated about the potential hazards of working with treating solutions, freshly treated wood and wastes generated by the treatment process. This section contains general observations on reducing risks at CCA wood preservation facilities. The information in this section comes primarily from EPA (USEPA 1984b and USEPA 1986). Specific recommendations for reducing risks at the Prescap operation in Shiringamazu are presented in the Recommendations section of this report.

Inhalation Hazards CCA solutions are aqueous and pose little or no threat of volatilization of inorganic arsenicals. The concern with inhalation is associated with arsenic in a dry form which occurs as dust at the facility. The small particles can be absorbed in the lungs and larger particles can be ingested. Workers are exposed to some arsenic particles throughout the plant as a result of leaching, drying and flaking of the CCA solution. Higher concentrations are associated with the mixing of powder formulations outside of closed systems.

EPA addresses the inhalation threat through two avenues. First, they require that the treatment process leaves no visible surface deposits on the wood, thus reducing the sources of arsenic dust. This requirement can be met by: using oxide formulations instead of salt formulations, treating "dry" wood, maintaining a clean facility, draining excess solution from the wood before final drying, and avoiding treatment solution sludging by minimizing contamination of solution and maintaining the proper chemical balance. EPA cites three industry standards for clean wood. Copies of these standards are on file in the USAID Mission in Lima. If the use of CCA in the Prescap processes produces surface sludging, as discussed above, the result would be not only an unsightly product, but also increased worker exposure.

Although EPA requires a clean product surface, its primary control mechanism for reducing inhalation is facility air monitoring and the use of respirators if the air contamination

* CCA, a water based preservative, has no vapor pressure, therefore, vapor inhalation is not a concern.

exceeds the Permissible Exposure Limit (PEL) of 10 micrograms per cubic meter.* A facility with airborne arsenic levels above the PEL is required to provide workers with MSHA/NIOSH approved respirators. Copies of the MSHA/NIOSH standards are on file in the USAID Mission in Lima.

The respirators are estimated to reduce the inhalation exposure by 99%. EPA also investigated the use of dust masks to reduce inhalation exposure. They estimated that dust masks would reduce exposure by 80%. Although EPA promulgated the respirator requirement, the 80% reduction estimated for dust masks would reduce the risks to within the same range (8.2 x 10exp-4) as EPA deemed "acceptable" for other control requirements (see Appendix D, "Handling freshly treated wood," "Brush-on Applications" and "Sawing/fabricating treated wood").

Skin Protection Skin contact is most likely to occur during mixing solutions, and handling treatment equipment and freshly treated wood. To reduce these exposures at treatment facilities EPA requires that mixing be conducted in closed systems (discussed below), impermeable gloves be worn when handling freshly treated wood and opening treatment cylinder doors, and that impermeable gloves, boots, overalls and jackets be worn when entering a treatment cylinder. When involved in brush-on applications of CCA, EPA requires that impermeable gloves and coveralls be worn to avoid contact with hands, arms and legs due to spilling and splattering.

EPA estimates that when only the hands will be in contact with the CCA, impermeable gloves can reduce the exposure by 90%; likewise, during brush-on applications, coveralls and gloves will reduce exposure by 90%; but when entering a treatment cylinder, full protective clothing will only reduce exposure by 80%. One other point to consider is that EPA based its exposure estimates on standard industry practices at U.S. facilities, i.e., workers are assumed to be dressed in long-sleeved shirts, long pants and shoes.

The application of these standards is complicated by the fact that impermeable coveralls can cause heat stress, an additional risk to the worker. This issue has not been raised in the U.S. in regards to the use of CCA, but it has come up in regards to EPA's original proposal to require coveralls for outdoor use of creosote and pentachlorophenol wood preservatives. In response to this concern EPA dropped the requirement for impermeable coveralls and in its place required "long-sleeved shirts, long pants, and impermeable apron." (USEPA 1986, p. 1336). It is interesting to note that EPA's estimated

* Koppers Company has conducted air monitoring at all of their vacuum pressure impregnation facilities using CCA and found virtually all samples to be below the PEL with most being below 5 micrograms per cubic meter during an 8-hour workday exposure.

cancer risks from dermal contact of equal amounts of pentachlorophenol and CCA wood preservative solutions are relatively similar. Thus one can speculate that where heat stress is a concern, the use of long-sleeved shirts, long pants and impermeable aprons could replace impermeable coveralls in CCA applications.

Mixing Solutions Exposure during mixing results primarily from suspension of powder formulations. To address this problem, the Koppers Company has been marketing only CCA liquid concentrates for over a decade. The risks associated with mixing liquid formulations are small. If powder formulations are used, EPA requires that they be mixed in a closed system where no arsenic can be released to the surrounding environment. This requires an automated system which pneumatically unloads powder from trucks into closed mixing tanks. In 1984 EPA estimated such a system would cost $10,000.

Personal Hygiene To avoid ingestion of CCA, EPA requires that applicators not eat, drink or use tobacco products while mixing solutions and handling treatment equipment or freshly treated wood. In explaining its position, EPA raised a general concern about even eating, drinking or using tobacco products around stacks of freshly treated wood. In addition, EPA requires that all workers wash their skin thoroughly before eating, drinking, using tobacco products or using the restrooms.

EPA requires that protective clothing be changed when it shows signs of contamination, thus reducing undue contact with the preservative. EPA also requires that protective clothing, workshoes, boots and other equipment be left at the treatment facility. This reduces exposure to workers' family members. Although such exposure has not been documented for CCA workers, risks to family members from exposure to work clothing has been documented in other industries where this route has been studied (e.g., the asbestos industry).

WASTE MANAGEMENT AND DISPOSAL

The wastes from CCA treatment facilities include used solution, runoff from the treatment and drying areas, sludges from treatment solution, used filters, contaminated dirt, and worn-out protective clothing. All of these wastes must be treated as hazardous and disposed of in a controlled manner.

EPA regulates waste from CCA wood preservation plants as hazardous wastes under the Resource Conservation and Recovery Act (RCRA). RCRA is a comprehensive waste management program, often described as "cradle to grave" waste management. It includes requirements for waste analysis, plant operation, disposal, location and design, record keeping, environmental monitoring, emergency preparedness, corrective action in the event of a release, facility closing, and post-closure environmental monitoring. At the risk of oversimplifying, the program's

primary objective could be described as containment of hazardous waste.

At wood preservation facilities in the U.S. containment is achieved by controlling and collecting all runoff from the treatment and drying areas, storing chemicals in contained areas, stabilizing wastes and disposing of wastes in contained landfills. Runoff control is achieved by installing contiguous, diked concrete pads under the process area, the drying area and connecting passageways. The runoff is collected for reuse in solutions or disposal. Likewise, drums of chemicals are stored on diked concrete pads which can hold at least 10% of the total storage volume or 100% of the largest tank, whichever is greater. Often storage area pads and dikes are coated with a chemical resistant epoxy to provide a greater margin of protection. All of the concrete containment structures must be inspected regularly for cracks so that their impermeability can be maintained.

According to Koppers Company, the most commonly used waste management method for CCA wood preservative facilities involves collecting and reusing as much liquid waste as possible and placing the residual wastes in 55 gallon, non-leaking drums and adding cement to the drums as they are filled to stabilize the wastes. When the cement has hardened, the drums are closed with tight-fitting lids and placed in hazardous waste landfills. The landfills must comply with RCRA requirements, which means they must have two impervious liners and a ground water monitoring system.

RECOMMENDATIONS

The previous sections give general information on the use and handling of CCA and disposal of its waste products. To supplement this information we have attached as Appendix E a report on the safe use of CCA prepared by Canadian industrial and governmental agencies This section of the report, however, presents specific recommendations for operation of the Prescap facility in Shiringamazu. These recommendations represent the views of all three members of the expert team.

Before listing our recommendations for the facility in Shiringamazu, we want to commend the advisors from the Tropical Science Center who designed the facility and developed the initial operating plans. We were impressed with the pollution control features already designed and in some cases constructed when we arrived at the site. We fully endorse these design and operation features including:

- cement pads under the treatment and fixing areas with a drainage system designed to contain any releases and direct them into a recovery tank,

- roofs over the treatment, fixing and drying areas,

- the use of liquid concentrates instead of powder formulations, their storage in a secured and diked area and the plans to maintain restricted access to the storage area,

- a decontamination room with an emergency high volume shower and storage area for work clothes,

- the provision of protective clothing to workers including coveralls and impermeable boots, gloves and aprons, as well as respirators for use in dusty areas,

- a fenced perimeter with controlled access, and

- the provision of information signs on the premises to remind the workers of the potential dangers of CCA and the need to maintain safe working conditions.

USAID has been fortunate in having such skilled advisors as Michael Krones and Guillermo Gonzalez working on this project. In addition, we were impressed by the quality of workmanship on the facility under the direction of the Peruvian construction advisor and the awareness of the Indian cooperative manager for the need for health and environmental controls.

Although we commend the work already accomplished or planned, we have additional recommendations which we believe will improve environmental management of the facility. We have divided our recommendations into seven categories: bark, sap, hazardous waste, facility design, employee training, facility management, and product testing.

Bark The operating plan for the Prescap facility calls for treating the logs with the bark on. Although there is reason to believe that the CCA will not cross the intact cambium, we believe that the cambium will not remain intact due to damage during felling and transportation as well as subsequent bark removal. Therefore, we believe that bark removed after treatment will have to be treated as contaminated waste. The environmental management goal of facility should be to reduce the amount of contaminated waste. To this end, we make the following recommendations concerning bark.

1. During the initial months of operation tests should be conducted to determine the feasibility of treating logs after bark removal. Treating logs without bark would be preferable to treating with bark because uncontaminated bark can be treated as normal sawmill wastes.

2. Bark removed after treatment should be tested to determine if it has been contaminated with CCA. In the short-term, bark contaminated with CCA should be disposed of in a secure landfill.

3. A secure landfill is one located on a hilltop or a topographic rise so that runoff does not enter the site. The site should have clay soils to a depth of at least one meter below the bottom of the landfill. During the filling of the landfill a temporary roof should be constructed over the site to prevent rainfall from entering the excavation. Before the temporary roof is removed, the landfill should be capped with a 250 cm layer of clay contoured to shed rainfall and planted with a vegetative cover to prevent erosion.

4. One of the greatest health risks from contaminated bark would be associated with burning the bark and subsequent inhalation of the smoke; therefore, all precautions should be taken to insure that bark with CCA is never removed from the facility to be used as fuel.

5. In the long-run, if the CCA is penetrating the bark and not sludging on the surface areas, the Project may be able to identify markets for treated bark, such as ground cover. Similar markets may also exist for untreated bark, and should be investigated.

Sap The Prescap process involves forcing the sap out of the log with the treatment solution. This process creates the potential for generating large volumes of hazardous wastes. Ideally, the sap should be separated from the treatment solution allowing disposal of the sap as a non-hazardous waste and recycling of the sap contaminated with CCA. Because of differential travel time through the log, however, the interface between the sap and the treatment solution will not be clearly delineated making separation difficult. We believe that a simple, litmus paper test can be used to segregate uncontaminated sap from CCA contaminated sap. This system relies on the fact that the CCA solution has a pH of less than 3, while sap has a pH of 6-7. For sap separation and disposal we recommend the following.

1. Two color coded containers should be kept at the discharge end of each log, one clearly marked for sap and the other for contaminated sap.

2. Litmus paper should be purchased and kept at the facility which is capable of identifying a drop in pH from 6 to 5. (In the early months of operation a study should be conducted to determine the pH of the saps for the species being treated so that a more refined calibration of litmus paper can be used as the project proceeds.)

3. When a log is to be treated, the sap container should be placed under the discharge end of the log and the litmus paper should be attached to the lowest point of the log's circumference (that point where the sap will drip off the log into the container). After the operator has cut the

disk from the log and reattached the Prescap, he should go to the discharge end of the log and watch the litmus paper. When it turns colors, indicating a drop in pH, he should replace the sap container with the contaminated sap container.

4. It is our belief that the sap collected under this system will be sufficiently free of CCA components so that it can be treated as a non-hazardous waste and disposed of by land application.

5. The contaminated sap should be recycled into the CCA solution.

Hazardous Waste The Prescap plant at Shiringamazu has been designed to reduce the amount of runoff which must be treated as a hazardous waste. The proposal to recycle contaminated sap also will greatly reduce the amount of hazardous waste. Of course, rainfall and runoff control and reuse of solutions will not remove the need for ultimate disposal. Treatment solutions will eventually reach a point where they can no longer be recycled and will have to be disposed of along with sludges and discarded filters and work clothing. The goal of disposal program should be to convert the waste into a usable product. Where this cannot be accomplished, the wastes should be converted to a form which is not readily leachable and disposed of in a secure landfill. Our recommendations for the disposal of hazardous wastes are as follows.

1. Liquid wastes (i.e., any liquids containing CCA which are not being recycled into the treatment solution) should be stabilized by mixing with sawdust until the sawdust has absorbed the liquid.

2. The stabilized waste (i.e., sawdust/waste mixture) can be mixed with cement and gravel to form bricks for use in construction. The mixture for the bricks should be made in the following proportions: **GILL INFO ON BRICKS** The resulting bricks will have the CCA fixed by the sawdust and encapsulated by the cement.

3. The bricks can be used for building foundations and walls and other uses where they will not be subject to abrasion (e.g., in floors or roads) or come in contact with potable water.

4. In the initial phases of the project the bricks can probably be used for construction in the project; however, a market study should be conducted to determine if there is a market for the bricks which could cover the costs of purchasing cement and making the bricks.

5. In the event that bricks cannot be made, the sawdust/waste mixture should be disposed of in a secure landfill as

described in the above recommendations for disposal of contaminated bark.

6. Used work clothing, used filters, and other contaminated solids should be disposed of in a secure landfill as described in the above recommendations for disposal of contaminated bark.

Facility Design The facility design already contains many features for protecting human health and the environment. Our recommendations on facility design are limited to reducing the amount of accidental releases, monitoring releases from the drying area, and providing capability for on-site chemical analysis.

1. All high pressure lines in the plant should be fitted with valves which will automatically shut off flow into the line with a sudden drop in pressure.

2. The plant should have an emergency alarm system with ready access throughout the plant, so that in the event of an accidental release, any worker can sound a general alarm.

3. The main compressor should have a clearly marked shut-off valve so that it can be immediately shut down in an emergency.

4. A runoff control system should be constructed around the drying area to prevent runoff from entering the area and eroding the soils under the poles.

5. During the initial months of operation, soil samples should be taken from the drying area and analyzed for the presence of CCA. If CCA is present in the soils, a concrete pad with drainage containment should be constructed beneath the drying area.

6. The plant should have a laboratory equipped with a drying oven, an analytic balance and an X-ray Fluorescence Analyzer for determining wood density and conducting chemical analysis of treatment solution and treated wood.

Employee Training As mentioned above, we concur with the plan to place information signs in the facility to remind the workers of proper handling of CCA. In addition, we have the following recommendations for employee training.

1. One plant employee should be appointed as a safety officer. In addition to his other duties the safety officer would be responsible for educating the other employees about safety practices, maintaining the advisory signs and chairing weekly safety meetings.

2. All plant employees should attend weekly safety meetings held during operating hours. At these meetings the safety officer should present safety information and the employees should identify safety problems they have noticed during the week.

3. USAID should consider contracting an industrial health and safety education specialist to work with the project staff and safety officer to develop a safety education program. To assist in this effort, the Koppers Company has provided as Appendix F of this report a Spanish language correspondence course on wood preservation, which includes sections on safe plant operation.

Facility Management In addition to the operation procedures already identified by the project staff, we recommend the following.

1. A substance control system should be instituted to track the life of chemicals at the facility including: 1) the quantity and date of arrival, 2) dates and location of storage, 3) dates and quantities mixed, 4) dates, quantities and types of wastes generated, 5) dates, disposal methods and location of disposal of wastes, and 6) in cases where wastes are used in products, the dates of manufacture, quantities and disposition of those products.

2. The water from the well at the plant should be used only for industrial purposes. Drinking water at the plant should come from a potable source other than the well.

3. Soils down gradient from the plant should be tested for the presence of chromium, copper and arsenic at six month intervals to ensure that contaminants are not moving off of the site.

4. The well at the plant should be tested for the presence of chromium, copper and arsenic at six month intervals to ensure that contaminants are not reaching the ground water. Appendix G contains sections from Standard Methods describing the analytic procedures for conducting these tests.

5. Chemicals should be transported to the plant on a truck which carrying no other items which could become contaminated and be a source of human exposure (e.g., food, clothing, household items). The chemicals should be transported in their original containers and secured to a shipping pallet.

6. The barrels in which the chemicals are shipped should be rendered unusable after the chemical is removed and disposed of in a secure landfill as described in the above recommendations for disposal of contaminated bark.

7. USAID should hire a long-term advisor (at least one year) to oversee the operation of the treatment plant and to train Peruvian counterparts from the project staff and the cooperative.

Product Testing The efficacy of the CCA retained in wood is predicated on not only a properly balanced proportion of the CuO, CrO_3 and AS_2O_3 in the cell cavities, but also retained in the cell walls to adequately protect the wood against fungal and termicital activity. There is some evidence to indicate that in the press-cap method, selective absorption of copper in green (fresh sawn) timber could throw the balance out in both the treated wood and the solution as well. Also, it would be anticipated that instantaneous reaction of the CCA with the sugars in the sapwood might generate substantially more "fall out" or sludging than would be realized with the vacuum/pressure impregnation method. Certainly it could be said that treatment by press cap should allow for a service life of the timber many times greater than utilizing the timber without treatment. If, in fact, selective absorption of CuO does occur, it may be necessary to obtain a 'specifically formulated' (fortified in extra CuO) CCA for use with the Prescap method.

Consequently, it is important that careful documentation of procedures, and results be undertaken. To this end we recommend the following:

1. An approximately 5 MM diameter x 4 CM length increment borings should be taken at approximately 1.9 meters from the butt end of each pole and a second at 1 meter from the tip of each pole. These constitute a set. Five poles, same species, five sets should be composited in sawdust form together to make an analysis by the ASOMA LCA (X-Ray spectographic method). Target retention for the groundline (1.9 M from butt) should be a minimum of 16 kg. of CCA oxides per M^3 of wood assayed. Target retention for the upper section of the pole (1 meter from tip) should be 12 kgs. of CCA oxides per M^3 of wood. This procedure should be followed carefully for the first two months of operation.

2. From the third month of operation and onward each pole should continue to be sampled as above except composite analysis should be for 20 poles.

3. Individual retentions for CuO, AS_2O_5 and CrO_3 should be noted and compared with standard retention values found in AWPA Standards.

4. In the case of fence posts, 10 posts (representing a lot of 60) should be composited and analyzed. Only one boring from each at approximate groundline would need to be taken. Retention in fence posts should be no less than 10 kgs./M^3.

5. Periodically, random samples should be tested, both at the plant and at an outside laboratory such as that at Koppers Company, Inc., so analytical procedures performed plantside can be compared with an outside analysis.

6. After having identified ten properly treated poles, these should be set aside to be planted in a test plot (graveyard) site situated in Peru, and a second internationally recognized site such as the one in Costa Rica. These should be monitored and evaluated every two years for sign of fungal and insect attack.

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APPENDIX D

EXECUTIVE SUMMARY FROM:

URBAN AND INDUSTRIAL POLLUTION ISSUES
AND ENVIRONMENTAL INFORMATION NEEDS IN THAILAND

The Conservation Foundation

URBAN AND INDUSTRIAL POLLUTION ISSUES AND ENVIRONMENTAL INFORMATION NEEDS IN THAILAND

A Background Paper for the:

THAILAND MANAGEMENT OF NATURAL RESOURCES FOR SUSTAINABLE DEVELOPMENT PROJECT

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Appendix A: Meeting Schedule for Lane Krahl and David Morell, July 13-31, 1987

Appendix B: Documentary Sources Consulted

ABBREVIATIONS USED IN THIS REPORT

AIT	Asian Institute of Technology
BMA	Bangkok Metropolitan Administration
DIW	Department of Industrial Works
MOI	Ministry of Interior
NESDB	National Economics and Social Development Board
NIDA	National Institute of Development Administration
ONEB	Office of the National Environment Board
TDRI	Thailand Development Research Institute
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

This report, prepared by Lane Krahl and Dr. David Morell for USAID/Thailand, identifies a potential program for addressing urban and industrial pollution problems and environmental information needs in Thailand. The introduction of the report is followed by ten sections each addressing a specific pollution problem or an environmental management need. These sections do not contain detailed project plans, but rather present project concepts with preliminary budgets. A summary of the proposed project schedules and budgets is shown in Table ES-1.

Integrated Environmental Management

Integrated environmental management, as currently being applied in the United States, could help overcome many of the principal problems confronting effective environmental management in Thailand. The integrated approach, where the focus is not on water, air or hazardous chemicals alone, but on overall environmental issues whatever their forms or causes, can help set priorities for effective action through feasible administrative procedures at affordable costs. The approach blends cross-media problem assessment with identification of feasible management options to determine priorities and control strategies.

The recommended approach in Thailand would commence with four district-level pilot projects, two each in Pathum Thani and Samut Prakan. Each project would encompass six steps: 1) development of a local advisory committee; 2) integrated analysis of environmental issues and identification of priorities; 3) development of effective management techniques; 4) management of environmental information; 5) public outreach activities; and 6) training and institutional development.

The integrated environmental analysis in each area would encompass assessments of health and environmental impacts as well as economic impacts of environmental degradation. The priorities developed through this analysis would then be reviewed in the light of the possible management techniques to address these problems. By integrating feasible control strategies with problem priorities an efficient environmental management system could be designed for each district.

The results of the pilot projects would then be used to take the approach nationwide, building on the capabilities of Thai government agencies and on incentives for effective environmental management by the private sector.

Environmental Information System

Environmental information is collected by many different agencies throughout Thailand; however, this information is virtually inaccessible to public officials making critical

decisions which affect the environmental quality of Thailand. ONEB has recognized this problem and has committed some resources to address it.

To assist in this effort, we recommend that ONEB undertake an assessment of the uses, users and sources of environmental information, and design a distributed information system to make this information available, in usable formats, to local and national officials. Distributed systems are particularly relevant to the Thai situation where many separate agencies will produce and use the information in the system, and where some key ministries are already introducing the use of personal computers into their operations.

Thailand also lacks a system to provide up-to-date information to first responders at the scene of a hazardous materials accident. To address this need, we recommend that USAID assist ONEB in developing an emergency response information center. The center could be modeled after the successful CHEMTREC program operated by the Chemical Manufacturers Association in the U.S. Because of its direct use to industries, the center could potentially receive partial funding from Thai industry.

Hazardous Industrial Materials Management

Thailand presently lacks information on the storage, use, transport, and fate of hazardous chemicals. To address this problem we propose a project with three components: hazardous materials inventories; hazardous substances management audits; and development of hazardous waste management and treatment capacity.

The inventory would begin by identifying all of the manufacturing facilities for chemicals and allied products in the Bangkok metropolis and the nearby provinces, extending work already completed in recent years. New inventory forms would be created to collect basic information on hazardous materials used, stored, and disposed of at each facility. The forms would be completed using existing government information, supplemented by survey information from the firms themselves.

With the inventory in hand, audits would be conducted at selected firms to help them devise techniques to reduce the generation of hazardous wastes and improve their capabilities to store and use dangerous chemicals in a safe manner. Audit procedures would be developed drawing upon the worldwide experience in waste reduction and hazard assessment gained in recent years. Individuals from Thai industry, universities and government agencies would be trained to carrying out the audits.

Finally, we propose to assess and then improve Thailand's capabilities to manage its hazardous wastes. The assessment would include a study of the new DIW facility on the outskirts of

Bangkok, including its collection system, and would pay special attention to the needs of smaller firms. The assessment would also address the need for viable funding mechanisms to construct and operate the facilities. Again, training and institutional development would be important parts of this component.

Although all of the components of the hazardous industrial materials management project will commence in the Bangkok area, over time the programs would be extended to firms in other provinces.

Emergency Response

Thailand unfortunately has already witnessed several industrial accidents involving hazardous chemicals; more accidents in the future seem unavoidable. While prevention could be improved and response information provided through the other activities proposed in this report, additional emergency response capabilities are surely warranted as well.

We recommend creating an emergency response system to ensure that adequate resources are available and coordinated, and personnel trained to respond to hazardous materials accidents when they do occur. Contingency planning is essential to effective response to such emergencies, and this project would work with local officials of the Ministries of Interior, Industry and Public Health, local industries, and community leaders to devise contingency plans to respond to chemical accidents. Working with local planning committees, the project would assess potential hazards; evaluate potential response capabilities; and strengthen these capabilities through training and equipment purchases. Plans, once developed, would be tested through drills and training exercises.

The local planning efforts would be supported on the national level by providing training opportunities and coordinating equipment and skill needs across regions. Extensive training would be provided throughout, perhaps under the auspices of the Ministry of Interior's Civil Defense School.

Bangkok Sewage Program

Water pollution in the Bangkok area -- predominantly from residential sewage -- is already a very serious problem. The dissolved oxygen level in the Chao Phraya River drops radically as it passes through Bangkok, and one international study predicts that if current practices continue, the lower portion of the river by the year 2000 will become anaerobic during low flow conditions.

We propose a five-part project to address the water quality problems associated with sewage disposal in Bangkok over the seven-year project period. The project would include assessments of the benefits of sewage control; of innovative and low-cost

treatment alternatives (as opposed to the $1.5 billion system proposed in the latest international plan); and of potential innovative funding mechanisms. The focus would be on identifying priority areas for sewage control. Once these studies are completed, facilities could be designed and developed. In addition, the project would look at opportunities to control sewage disposal from new sources of potential contamination, thereby incorporating some of the social costs of water contamination into the private costs of new construction in the metropolis.

Solid Waste Management

Over 27 million kilograms of solid waste are generated each day in Thailand. Most of this waste is disposed of in open dumps, and seldom do the fees charged for disposal cover the operation of even these inadequate systems. Although the solution to the solid waste problems in Thailand will involve changes in technology, the problems are not merely technical, but have management and economic components. Clearly there is a need to address system management, fee structures, economic feasibility of alternative technologies, and end-product marketing issues.

We recommend five different activities to deal with selected aspects of Thailand's solid waste management problems. Four of these activities involve economic and management studies of: composting; the informal recycling market; possible solid waste treatment alternatives; and financing options. The fifth proposed activity is a program to disseminate the information and results of these various studies, and to facilitate their implementation.

Performance Incentives for Environmental Management

In contrast to reliance on traditional techniques of environmental management -- collecting monitoring data, setting standards, enforcing permit conditions -- we propose to explore alternative approaches which may be more feasible for effective implementation in the Thai setting. These non-regulatory, economic incentives may be highly effective in causing real environmental improvements.

Through an in depth policy analysis, this project would explore a range of incentive techniques. Among these techniques would be tax-and-rebate schemes for hazardous waste management and disposal, and beneficiary taxes such as a "hotel fee" to finance urban environmental improvements which benefit tourism. Effluent taxes, having a long history in the literature on environmental management, would be studied for possible use in Thailand in the near future. We also propose an analysis of changes in pollution fines and other enforcement penalties, possibly tying them to a firm's economic gain from violation, thus creating proper incentives to comply.

Environmental Education

Direct involvement of the Thai populace is essential to any long-term strategy for environmental improvement. To this end, we recommend a program to increase public awareness of environmental issues as well as to create opportunities for constructive public involvement.

One means to increase public awareness is to strengthen the existing environmental curricula in the primary and secondary schools by developing supplemental units to give students hands-on understanding of the environmental issues in their own region and community. This effort would involve developing new materials as well as training teachers to use these materials.

To create the opportunity for increased public involvement in environmental management, we propose that ONEB undertake a study to identify where in its decision making structure public participation would be desirable and possible. ONEB could then develop mechanisms for effective public participation and train its staff in the use of these mechanisms.

Another way for ONEB to develop public support for its programs is to improve its public communications activities. To this end, we propose that they develop public service announcements for television and radio and videocassettes for use in the classroom and at public meetings.

Training and Institutional Development

One of the great advantages presented by a multi-year program is the opportunity to approach training and institution building comprehensively. By the end of the seven-year program, it is feasible for Thailand to have sufficient human resources and a set of competent institutions capable of providing leadership and direction for environmental management.

Throughout the projects in this report we have included training components. This section presents a training and institutional development strategy which goes beyond any one project. The strategy has seven elements. First, we propose to create new Centers of Excellence in Natural Resources and the Environment at 13 different universities. Each center would specialize in a specific discipline with a long-term program of teaching, research, and training.

A separate institutional development effort is proposed for ONEB. ONEB's capabilities are central to the success of environmental management in Thailand. They could be improved through a deliberate program of training, education, technology transfer, and information exchange.

The Ministry of Interior Academy is another key institution for long-term training in environmental management. We propose

to add further environmental components to the curricula for Governors and other local officials.

The creation of a new Thai Public-Private Partnership on the Environment is also proposed. It would be modeled on recent U.S. experiences with cooperative efforts by industry, environmental organizations, and state and local governments to address environmental problems.

International Fellows could be assigned to The Conservation Foundation in the U.S., to gain additional perspective and exposure to environmental management in the U.S. and to assist in overall coordination of the seven-year project.

Non-governmental organizations will play an increasingly important role in effective environmental management in Thailand. Symposia and seminars, information exchanges, and special training projects would be necessary to help them develop their capabilities as effective participants.

Finally, we propose to consider the possible creation of the new post of Deputy Governor for Environmental Management, as a way to better coordinate the vast range of different programs affecting the environment.

Conceptual Overview

USAID and the Royal Thai Government are embarking on an enormously ambitious undertaking in this overall Thailand Management of Natural Resources and Environment for Sustainable Development Project. In addition to an effective management plan, we believe that a continuing conceptual overview to assess the effectiveness of the complete Project would be critical in an effort of this scale and complexity.

We propose an annual assessment of basic progress in all components of the Program -- land and water resources management, biological conservation, coastal resources management, urban-industrial environmental quality, and institutional strengthening. This review would involve the professionals working on the individual projects as well as outside experts from the U.S. and Thailand. To facilitate the review, an annual symposium would be held in Thailand to deal with the cross-cutting conceptual issues.

Table ES-1

Summary of Schedules and Budgets for Urban and Industrial Pollution Control Projects

PROJECT	Year 1	2	3	4	5	6	7	BUDGET (1,000$s)	TOTAL
Integrated Environmental Management									8,500
Pilot Projects								1,500	
National Application								5,000	
Implementation Capital								2,000	
Environmental Information System									1,650
Environmental Data and Information System									
o Design								150	
o Installation								400	
o Training and Management								500	
Emergency Information System									
o Design								60	
o Installation								300	
o Training and Management								240	

PROJECT	Year 1	2	3	4	5	6	7	BUDGET (1,000$s)	TOTAL
Hazardous Industrial Materials Management									3,200
Bangkok Program									
o Inventory								100	
o Audits								300	
o Hazardous Waste								900	
o Training								150	
Expanded Program									
o Inventory								100	
o Audits								500	
o Hazardous Waste								1,000	
o Training								150	
Emergency Response									1,600
Contingency Planning								400	
Training								1,200	
Bangkok Sewage									5,600
Benefit Assessment								100	
Technology Assessment								100	
Funding Mechanisms								50	
New Source Control								50	
Implementation Plan								300	
Implementation								5,000	

PROJECT	Year 1	2	3	4	5	6	7	BUDGET (1,000$s)	TOTAL
Solid Waste Management									600
Compost Study								100	
Recycling								100	
Treatment Alternatives								100	
Fees/Management Options								150	
Info Dissemination								150	
Performance Incentives									950
Study Design								50	
Study								400	
Implementation								500	
Environmental Education									1,200
Environmental Curriculum									
o Assess Curriculum								50	
o Develop Materials								100	
o Train Teachers								250	
Public Participation									
o Design Program								30	
o Design Training								70	
o Train CMEB Employees								250	
Public Communications									
o Produce Public Service Announcements								250	
o Produce Videocassettes								200	

PROJECT	Year 1	2	3	4	5	6	7	BUDGET (1,000$s)	TOTAL
Training and Institutional Development									5,475
Centers of Excellence								3,955	
ONEB								670	
MOI Academy								250	
Public-Private Partnership								110	
International Fellows								350	
Non-Governmental Organizations								80	
Deputy Governors								60	
Conceptual Overview									175
Staff Time								63	
Outside Experts								112	
TOTAL COSTS (1000$s)	2600	3583	4847	4822	4422	4338	4338		$28,950