Environmental Issues in the Thai Pulp and Paper Industry

and

Improved Management and Quality Assurance of Chemical Measurements for Environmental Laboratories

April 13-22, 1993

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with Sponsorship by:

The United States Agency for International Development (USAID)/ Thailand

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This project is supported by the U.S. Agency for International Development and the World Environment Center. The opinions expressed herein are the professional opinions of the authors and do not represent the official position of the Government of the United States of America or the World Environment Center.

Section 1

Executive Summary

From April 13 to 22, 1993, Dr. Tondeur, Vice President of Technology, Triangle Laboratories, Inc., visited Bangkok, Thailand on a mission sponsored by the World Environment Center under a cooperative agreement with the United States Agency for International Development (USAID). The purpose of the mission was to participate in a series of activities promoting the need for improved management and quality assurance of chemical measurements for environmental laboratories in Thailand.

Thailand has experienced two decades of intense industrial growth and has begun to address its environmental pollution problems. The Thai government has been signaling its determination and intention to make the responsible parties accountable. In response, industry is taking a proactive stand by investing in and implementing environmentally sound technologies.

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Section 2

Introduction

The purpose of the mission was twofold.

A. Phoenix Pulp and Paper Seminar on Dioxin

The first responsibility included participation in a seminar on environmental issues for the pulp and paper industry in Thailand and delivery of an oral presentation on analytical methods for the determination of trace quantities of polychlorinated dibenzodioxins and dibenzofurans ("Dioxins") in pulp and paper mill effluents.

The April 16, one-day seminar was organized by Indian-owned Phoenix Pulp & Paper Co., LTD, which is the largest paper producing mill in Thailand. Last April, provincial authorities in northeast Thailand ordered the closure of the plant for dumping untreated waste waters into the Pang River, citing the company for BOD violation. Phoenix lost $2.5 million in revenues during the six-week shutdown period. This Thai government action is a signal of their determination to address the environmental effects of industrial pollution caused by the heavy industrialization in Thailand over the past two decades. During the visit, unconfirmed reports announced the shut down of another mill by the Ministry of Industry for pollution problems.

B. Seminar on Management Techniques for Environmental Chemical Analysis Laboratories

At the invitation of WEC, the second responsibility was to deliver a three-hour long seminar on management techniques for environmental chemical analysis laboratories on April 21. The seminar and the workshop that followed were organized by the Environmental Engineers Association of Thailand (EEAT), the Industrial Works Department - Ministry of Industry (IWD) and the World Environment Center (WEC) under a cooperative agreement with USAID-Thailand.

By sponsoring this conference, the World Environment Center set the stage to play a catalytic role in cultivating awareness and formulating an action plan for the analytical chemical laboratory community and the data users (i.e., the Industry and the Government). The groups participating in the conference will be developing a recognized, effective and strongly needed testing laboratory accreditation program.

Section 3

Findings

A. Phoenix Pulp & Paper Co., LTD Seminar

The one-day symposium organized by Phoenix was attended by nearly 110 people. The meeting was held on Friday April 16 from 9 A.M. to 4 P.M. at the Imperial Hotel in Bangkok. A total of six technical papers were presented ranging from reviewing the "dioxin" issue, to the analysis of "dioxin" using the state-of-the-art methodologies, to the biological effects of bleached pulp mill effluents and the construction of wetlands for the treatment of wastewaters.

The purpose of the oral presentation on "dioxin" analytical measurements was to offer an overview of the state-of-the-art methods as presently practiced by the western world for trace levels of "dioxins" in mill effluents. The presentation was designed to be mostly informative without spanning over the technical details. Emphasis was placed on definition of terms (e.g., "dioxins", parts-per-quadrillion) frequently encountered when dealing with "dioxin" measurements, the steps followed by the laboratory and what to expect from the laboratory providing the analytical results.

Phoenix Pulp & Paper Co., LTD employs approximately 840 people and is considered to have the largest paper manufacturing facility in Thailand. At the facilities Dr. Tondeur visited April 19, the company manufactures short-fiber pulp from eucalyptus and bamboo chips with a capacity of 100,000 tons per year at a number of locations. It has been said that starting next year, Thailand's capacity will exceed domestic needs. As a result,the industry should be looking to export pulp, bleached pulp and paper products.

At the seminar, Mr. Mittal, Managing Director of Phoenix Pulp and Paper Co., LTD, announced the construction of a new sewage treatment facility to meet government requirements and the conversion of the facilities from a chlorine bleaching process to an oxygen bleaching process to reduce the risk of "dioxin" formation. Although no regulations currently exist in Thailand regarding the emissions of organic pollutants (such as "dioxin"), Phoenix Pulp & Paper Co., LTD decided to take a leadership role in pollution prevention and control by investing and introducing technologies that have been evaluated successfully in Europe and North America.

Based on the information made available and interactions with key people during the visit, Dr. Tondeur envisions that, within the next couple of years, the Thai government will promulgate new regulations to better control the emission levels of organic pollutants into the environment. Today, no such requirements are imposed on the industries. Biological oxygen demand (BOD), chemical oxygen demand (COD), color, pH, total suspended solids (TSS) and a few metals are amongst the types of testing presently required for discharge permits.

It is only very recently that the government enacted pollution prevention legislation (e.g., hazardous wastes regulations). Currently, Thai officials appear more preoccupied with fundamental pollution problems than with "dioxin" emissions. Initially, if "dioxin" testing needs should develop in Thailand, it would be because of activities related to industry/university research and development efforts. In addition, with growth into export markets, the Thai paper industry may be required to have its products tested for "dioxins" as done today by most North American and European companies. Another driving force could be from foreign corporations that need to obtain an environmental impact assessment to comply with country of origin laws (e.g., U.S. laws regarding the purchase of commercial properties and the liabilities associated with owning "Superfund"-type sites).

On a separate note, Dr. Tondeur had the opportunity to meet and talk with Mr. Phairuch Mekarpom (Managing Director of Thai Paper Co., LTD), Mr. Adul Udol (Managing Director of Siam Kraft Industry Co., LTD), Mr. Alan D. Lovas (Senior Project Engineer from Kimberly Clark) and his wife Louise Lovas (Senior Regulatory Affairs Associate, Worldwide Safety & Surveillance from Bristol-Myers Squibb Pharmaceutical Research Institute) some 39,000 feet above the Pacific Ocean on his way to Tokyo, Japan and Bangkok, Thailand. The general feeling from the pulp and paper industry in Thailand is that "dioxin" will not be an issue for at least two years. Dr. Tondeur also discussed how Triangle Laboratories is successfully applying the technology developed for "dioxin" testing to specific problem solving for the pharmaceutical industry in the USA.

Furthermore, Phoenix Pulp & Paper Co., LTD is constructing a man-made wetland for secondary treatment of their effluent. Dr. Donald Hammer, Tennessee Valley Authority (TVA), presented a paper on constructed wetland wastewater treatment technologies. The World Environment Center (WEC) has worked over the past two years to introduce this US-based technology to Thailand in cooperation with the United States Agency for International Development (USAID), Bicentennial Volunteers, Inc. and TVA.

This technology is a proven low-cost system for the treatment of both domestic and industrial wastewaters. The system is made of a series of lagoons where plant, animal, bacteria and fungi populations naturally associate and interact, acting as a natural filter. These organisms serve to transform, degrade and absorb a wide variety of pollutants through both biological and physical means.

Improved Management and Quality Assurance of Chemical Measurements for Environmental Laboratories Seminar

The seminar and workshop took place between 8:30 A.M. and 5 P.M. on Wednesday April 21 at the YMCA in Bangkok. Sixty people attended the seminar, including representatives of the government (Ministries of Industry, Interior, Pollution Control Department), Universities (including the Dean of the Sciences Faculty, Kasetsart University, Dr. Sumin Smutkupt), the Industry and testing laboratories. For a more detailed list of the participants, refer to Appendix E, Item 8.

For the morning session, Dr. Tondeur used overheads and conducted a more informal, "sharing-his-experience-in-the-management-of-a-chemical-analysis-laboratory" discussion, inviting the participants to share their experiences as well.

Dr.Tondeur began the afternoon workshop with another presentation (approximately 30 minutes). This speech covered quality assurance for the chemical measurements in environmental laboratories and accreditation and certification issues as they are currently considered in the USA. WEC facilitated this workshop in Thai to increase audience participation and success in developing an action plan.

C. Facility Visits

Pulp & Paper Mills (19 April 1993)

Dr. Tondeur visited three pulp and paper companies, Siam Cellulose Co., LTD, Thai Kraft Paper Industry Co., LTD and Thai Union Paper Co., LTD located in the Wang Sala Complex (approx. 200 km from Bangkok). Dr. Tondeur was accompanied by Mr. Tanaka from GK Finechem Co., LTD from Bangkok and Mr. Fujita from Mitsubishi Petrochemical Co., LTD. We spoke with Siriporn Phawakarakun, a chemist from Siam Cellulose who welcomed us and requested information on "dioxins" testing. A visit of the mills was not possible.

Environmental Research & Training Center (20 April 1993)

ERTC of the Office of the National Environment Board of Thailand was given the mandate to coordinate efforts in environmental research and methods development, training (sampling and analysis) and monitoring nationwide. The center is also a principal advisor for administrative policies to the Office of Planning and Environmental Pollution Control.

The facilities were dedicated in November of 1991 with a $20 million grant from Japan, which can be viewed as an example of the working relationship between Thailand and Japan. Half of this money was used for construction of the facility and the other half was used for the acquisition of instrumentation. The facility is equipped with various modern scientific instrumentation such as a high-resolution GC-MS system, several GCs, X-ray fluorescence spectrophotometer, atomic absorption spectrometer, scanning electron microscope and an air and water mobile laboratory. All instrumentation is from Japanese manufacturers (e.g., Jeol, Shimadzu).

The facilities are located in Pathumthani and are currently staffed with 104 people. Another 23 people were approved in this year's budget. The trainees have access to very inexpensive ($3 a night) and modern housing within the main complex building.

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Dr. Tondeur was accompanied by Mrs. Wanida Srichai from WEC and Mr. Tanaka from GK Finechem Co., LTD. They were received by Dr. Monthip Sriratana Tabucanon, Director of the center. Dr. Monthip showed us the facilities and instrumentation laboratories. She spoke highly of the relationship with the Japanese government and the financial help the Japanese government provided for equipment. Dr. Monthip commented that donors from the United States usually provide software and training supports but do not assist much with the acquisition of hardware.

Dr. Monthip strongly emphasized the fact that the Thai needs in analytical methods were quite different from the United States. This is mostly because the complexity and contamination levels typically found in the Thai environmental samples are different than in the U.S. The ERTC is in fact using US EPA's and other countries' methods mostly as a source of inspiration and is adapting them to their specific needs. She indicated the need for sending Thai chemists to the US for training purposes. Dr. Monthip was very critical of the lack of acceptable certification of laboratories in Thailand and thus was very interested in the upcoming seminar and workshop organized by WEC. Dr. Monthip is expected to attend a conference in Washington, D.C. next July on the subject of laboratory certification.

San. E 68 Consulting Engineers Co., LTD (20 April 1993)

Mrs. Wanida Srichai (WEC) and Dr. Tondeur visited a "typical" Thai laboratory in Dusit, Bangkok. The laboratory visited is staffed with approximately 10-15 people and is equipped for tests such as metals (AA), BOD, COD, pH, colorimetry, oil & grease, suspended solids, dissolved solids, phosphate, nitrate, odor in waste and drinking waters. There are approximately 22 laboratories in Thailand. The laboratory visit provided some insights into the Thai laboratory environment, its capabilities and structure to help guide the upcoming seminar on laboratory management and accreditation.

D. Miscellaneous

Prof. Thongchai Panswad's group -- Secretary General of EEAT-- is currently writing a dictionary on terms (e.g., blender, mixer, homogenizer all have the same word in Thai). His group has also published a manual (in Thai) on wasteater analysis. No specific organics testing except some phenol, organic nitrogen, phosphates etc. are included in this document. In that respect, once organic compounds testing become necessary, Triangle Laboratories and ERTC could provide the technical expertise in support of EEAT's endeavor.

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Section 4

Conclusions & Recommendations

Thailand is addressing very vigorously its environmental pollution problems by setting examples, as well as developing and promulgating appropriate regulations. Industry seems to be taking a proactive stand in these matters through interest in and implementation of environmentally sound technologies. From a chemical analysis laboratory point of view, the Thai market for organic testing is still very immature.

However, Thailand should be considered as a possible site in South-East Asia for the implementation of a laboratory capable of providing full-scale services. A strategic alliance or partnership between an existing Thai facility and Triangle Laboratories may offer an appealing approach to setting up a laboratory capable of performing the kind of testings and of delivering the level of quality Thailand will need in the future.

The seminar on management techniques for chemical analysis laboratory and accreditation was also appropriate and timely in light of upcoming regulations on organic pollutants. These testings are much more involved and elaborate than BOD-type analyses and will require more stringent quality assurance and quality control procedures.

WEC in its facilitator role is to be commended for its efforts and vision. A momentum is building up and it is important that these efforts receive the proper level of attention, support and follow-up by all the parties involved. WEC, as a nonpartisan entity, has gained the confidence of the government and the Industry and is well positioned to provide this leadership role.

Picture 1. Breakfast Meeting between Mr. Chalat Sripicham (right) --WEC Country Director, Thailand-- and Dr. Tondeur.

(15 April 1993; Amoma Swiss Hotel, Bangkok, Thailand).

Picture 3. Round-Table Happy-Hour Discussion between, from left to right, Dr. Prasert Tapaneeyangkul (Ministry of Industry), Mr. J. Gober (BVI), Dr. Tondeur and Dr. Donald Hammer (Tennessee Valley Authority).

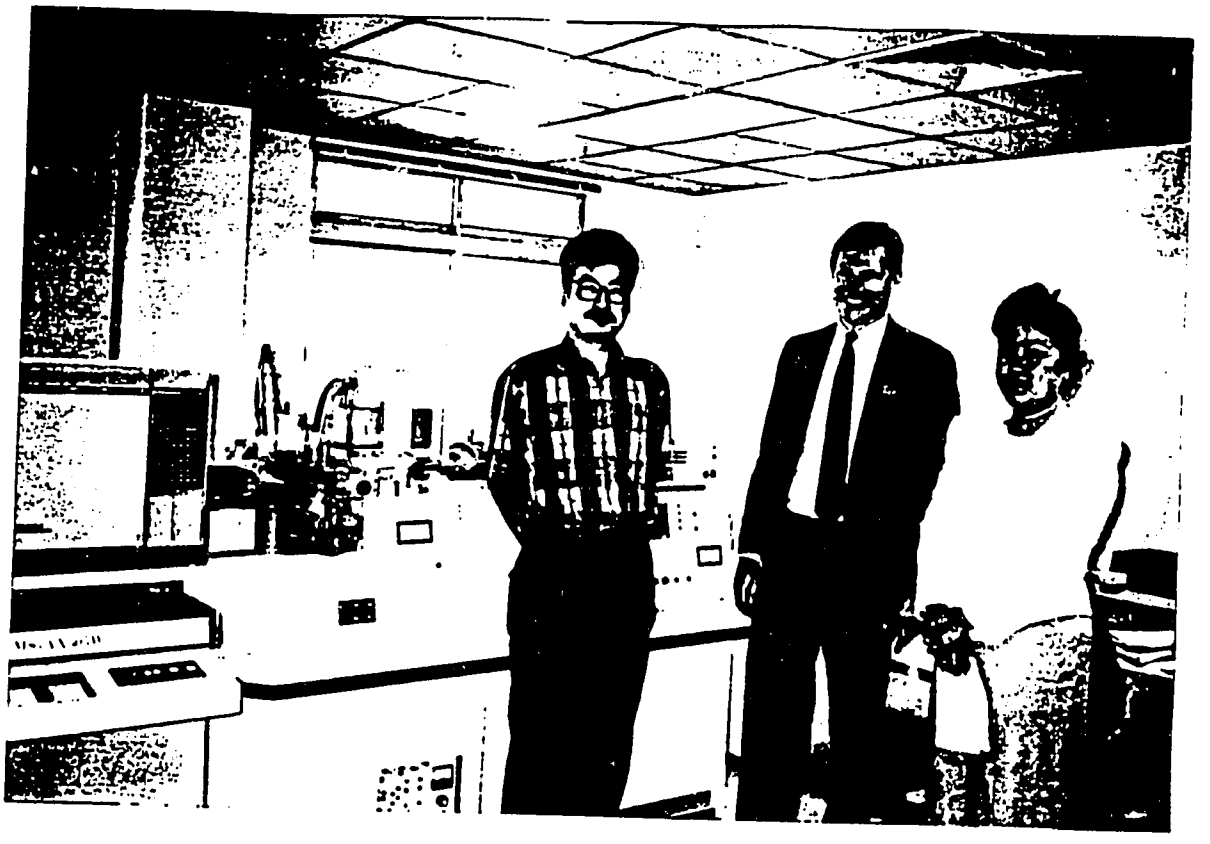
(16 April 1993; Imperial Hotel, Bangkok, Thailand.)

Picture 2. Discussion at the Conclusion of the Pulp & Paper Seminar between, from left to right, Mrs. S. Piya (Ministry of Science and Technology), Mr. Y. Jushutip (Environmental Research and Training Center), Mr. S.K. Mittal (Phoenix Pulp & Paper Co., LTD.), Mr. James L. Gober (Bicentennial Volunteers, Inc.) and Dr. Tondeur.

(16 April 1993; Imperial Hotel, Bangkok, Thailand.)

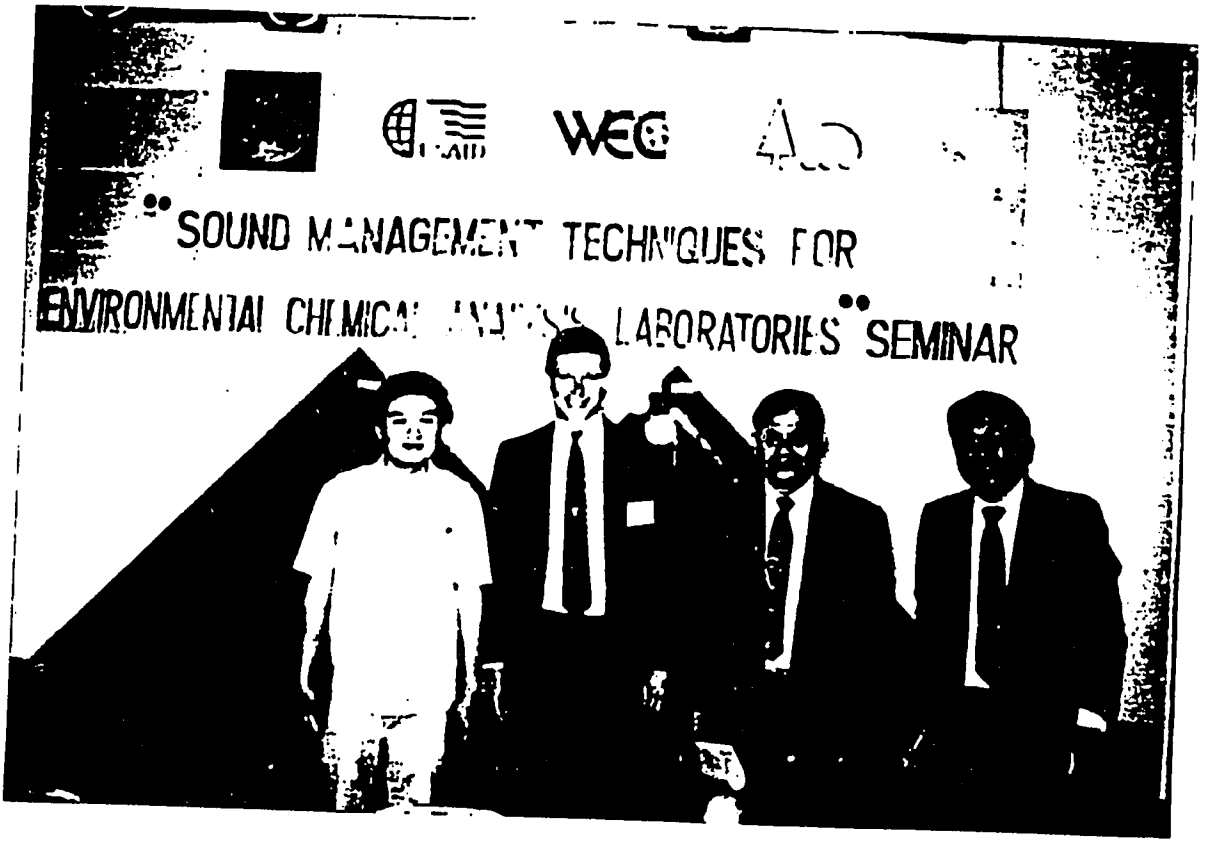
Picture 4. View of the South-East Side of the Environmental Research and Training Center (Office of the National Environment Board).

(19 April 1993, Pathumthani, Thailand.)



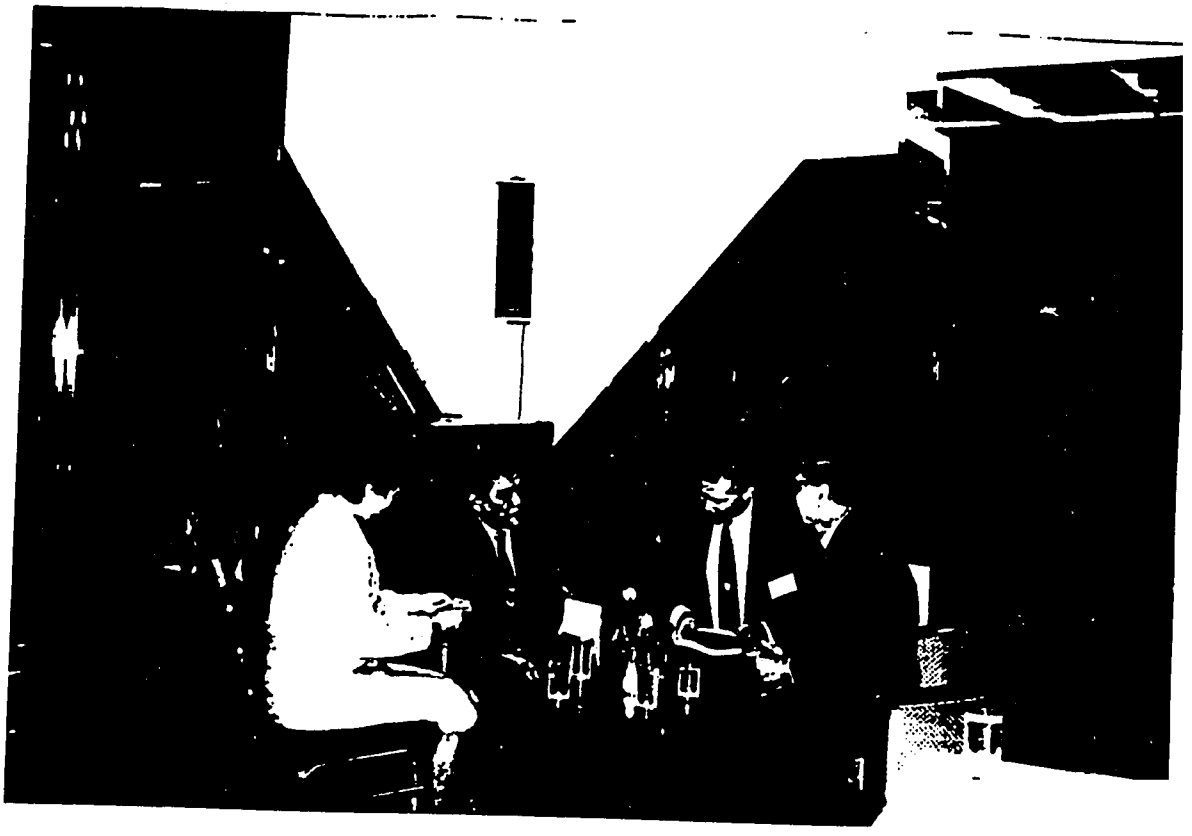
Picture Picture 5. From left to right, Drs. Seiji Watanabe (ERTC), Tondeur and Monthip Sriatana Tabucanon (Director, ERTC) posing in front of a double-focusing Jeol JMS-AX505W gas chromatograph-mass spectrometer system.

(19 April 1993, ERTC, Thailand.)



Picture 6. Scene Taken at the Kick Off of the Seminar on "Sound Management Techniques for Environmental Chemical Analysis Laboratories". From left to right, Dr. Suchint Phanapavudhikul (Environmental Engineers Association of Thailand), Dr. Tondeur, Mr. Prapas Thanakul (Deputy Director General, Industrial Work Department, Ministry of Industry) and Mr. Chalat Sripicharn (WEC).

(21 April 1993, YMCA, Bangkok, Thailand.)



Picture Picture 7. Round-Table Discussion Preceding the Seminar including IWD (Mr. Papras Thanakul), WEC (Mr. Chalat Sripicham) and Dr. Tondeur.

(21 April 1993, YMCA, Bangkok, Thailand.)

Pictures 8 & 9. Scenes Taken During the Seminar.
(21 April 1993, YMCA, Bangkok, Thailand.)

Appendix B

Itinerary

Location, Name and Date of the Facilities Visited

Date	Name Facility	Location
19 APR 93	Siam Cellulose Co., LTD	Kamchanaburi
19 APR 93	Thai Union Paper Co., LTD	Kamchanaburi
19 APR 93	Thai Kraft Paper Industry Co., LTD	Kamchanaburi
20 APR 93	Environ. Research & Training Center	Pathumthani
20 APR 93	San.E68 Consulting Engineers Co., LTD	Dusit Bangkok
20 APR 93	Construction Site (Tropical Constructed Wetland)	

Appendix C

Persons & Organizations Visited

Person Name	Organization
Mrs. Siriporn Phawakarakun	Siam Cellulose Co., LTD
Dr. Monthip Sriratana Tabucanon	ERTC
Dr. Seiji Watanabe	ERTC
Mr. Romran Srisamrit	San.E68 Consul. Eng. Co., LTD

Appendix D

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70 MOO 5 KINGKAEW RD., BANGPHLI SAMUTPRAKARN 10540, THAILAND
TEL. 312-4159, 312-4165-7, 312-4171-5
FAX : (662) 312-4162

ROONGNAPA CHITARADHIRA (B.Sc.)
SALES REPRESENTATIVE
GENERAL INDUSTRIAL CHEMICALS DIVISION

LOXLEY

LOXLEY (BANGKOK) LIMITED
304 Sunpoh Road, Bangkok 10100, Thailand.
Tel. 221-6121 (10 LINES) 225-0199 (15 LINES)
Fax: (662) 2244499 Telex: 81188 LOXLEY TH
Direct Line: 2244495, 2247860
Pagephone: 161, 162 Ext. 100064

ฐิติพงศ์ วงศ์สวัสดิ์
THITIPONG WONGSAWAD

廣大國際貿易有限公司
GREATER INTERTRADE CO.,LTD.
廣大國際貿易有限公司

3384/30-31 SOI MANOROM,
RAMA 4 ROAD, KLONGTOEY
BANGKOK 10110

TEL 2401400-3, 2498017-8
FAX (662) 2498752, 2493838
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388 Phaholyothin Road,
Phyathai, Bangkok 10400

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Telex : 81164 INTENCO TH
Telebox 290215 INTENC TH

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GENERAL MANAGER
PLANNING AND CORDINATION DEPARTMENT
CORPORATE BUSINESS DEVELOPMENT DIV.

MITSUBISHI PETROCHEMICAL CO. LTD.

MITSUBISHI BUILDING,
5-2, MARUNOUCHI, 2-CHOME
CHIYODA-KU, TOKYO
100 JAPAN

PHONE. 03-3283-5353
TELEFAX 03-3283-5808
TELEX. 222-3172 DIAPTC J

Johnson & Johnson (Thailand) Limited

WICHIAN JANGSIRIPORNPAKORN (Pharm.)
CHIEF INSPECTOR (PKG-&-FG)
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106 Moo 4, Lat Krabang Industrial Estate, Chalong Krung Road,
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Tel: 326-0193, 326-0968-71 Fax: 326-0747
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ดลฤดี มีคณี
DONRUDEE MEEKANEE
Environmental Scientist

mt&t

บริษัท โมเดิร์น ทรีท แอนด์ เทค จำกัด
MODERN TREAT & TECH CO.,LTD.
288/10 SUNWONGSE ROAD, BANGKOK 10500, THAILAND P.O. BOX 6
TEL. 237 5341-2 FAX (662) 237 5342 TELEX: SUCO TH. 82775

Sam. E 68

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ANCHALEE RUKSAPAN
นักวิทยาศาสตร์

ผู้ชำนาญระบบน้ำดีและน้ำเสีย
- [illegible]

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- [illegible]

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57 ซอยยาสูบ 1
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กรุงเทพ 10900
Tel. 2713347 2785736 2787184 Fax. 2713347

SECOT Co.,Ltd.
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Chatujak Bangkok 10900
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วราภรณ์ หิรัญวัฒน์ศิริ
Waraporn Hiranvatsiri
Manager

บริษัท เอส ที เอส เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด
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196/10-12 ถนนประดิพัทธ์ กรุงเทพฯ 10400
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TESCO LTD.

Engineering, Architectural
Environmental Consultants

จันทรา เกิดมี
JUNTRA KERTMEE
Environmentalist

TESCO LTD.
21/11-14 Soi Sukhumvit 18
Bangkok 10110, Thailand

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258-1340, 259-6573-7
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Telefax: No. (662) 236-3110, 237-1164

บริษัท เทสท์ เทค จำกัด
TEST TECH CO.,LTD.

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EXECUTIVE DIRECTOR

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99/26 28 RAMA 2 ROAD BANGKHUNTIEN BANGKOK 10150
TEL. 4165117, 01-9141206, FAX. 4164237 HOME: 5707213
4153C56 . EY1 .31,32

โครงการการจัดการสิ่งแวดล้อมอุตสาหกรรม
สภาอุตสาหกรรมแห่งประเทศไทย
THE INDUSTRIAL ENVIRONMENTAL MANAGEMENT PROGRAM
THE FEDERATION OF THAI INDUSTRIES

Thiti Chantangphol
Environmental Engineer

[illegible]

เอียด สุนทรอารมณ์
Ied Soonthornarrom
Head of Q.C.

บริษัท กระดาษสหไทย จำกัด
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พระประแดง สำโรงใหญ่
สมุทรปราการ
โทร. 394 0622-4

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PRASARS KARNCHANABATR
MANAGING DIRECTOR

UDP CHEMICAL CO., LTD.
77/6 Moo 9, Soi Klongnongyai, Sukhaphiban 1 Rd.,
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Fax : 273-8169
Tlx : 21973 TOCL TH

United Analyst and Engineering Consultant Co., Ltd.

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Unocal Thailand, Ltd.
Songkhla Training Center
P.O. Box 76
Songkhla 90000, Thailand
Telex 60402 UOCTSK TH
Tel (074) 312-560 Fax ~~311-690~~
(074) 321/92

UNOCAL 76

Sakchai Suddevgrai
Section Head, Laboratory Services
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แขวงบางซื่อ
เขตบางซื่อ
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Charansanitwong 96
Bangsue Bangkok
Bangkok 10700
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วารุณี วิจิตรพนมศิลป์
WARUNEE WICHITPANOMSILP
TECHNICAL DEPARTMENT

WARM
WARM INTERNATIONAL CO., LTD.
บริษัท วอร์ม อินเตอร์เนชั่นแนล จำกัด

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72073 PETOKEM TH
Cable: "POLYTHENE" BANGKOK
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Appendix E

List of Documents Received

1. WEC 1991 Annual Report.
2. Every day is Earth day, WEC.
3. WEC Thailand Office, Activities in Thailand from July 1, 1991.
4. Draft WEC Thailand and Asian Programs.
5. The Environmental Research & Training Center (Brochure).
6. San. E 68 Consulting Engineers Co., LTD (1992 Price List).
7. UDP Chemical Co., LTD (UDP Activated Carbon, Brochure).
8. List of Participants to the April 21 Seminar.

Appendix F

List of Documents Provided to WEC

List of Technical Literature Donated
by
Dr. Yves Tondeur
to
World Environment Center (WEC) Thailand

On April 15, 1993

I	**M = Analytical Methods for Dioxins**	
	M1 = 8290 (IARC)*	(38 Pages)
	M2 = 8290 for Air (IARC)*	(22 Pages)
	M3 = Federal Register 1613	(44 Pages)
	M4 = Federal SW846 8290	(69 Pages)
	* Copy of book cover page	
II	**R = Review Articles on Dioxin**	
	R1 = Review *	(4 Pages)
	R2 = Toxicology *	(25 Pages)
	R3 = Epidemiology *	(19 Pages)
	R4 = Occurence in Human * & Exposure Routes	(53 Pages)
III	**G = Good Laboratory Practices**	
	G1 = TSCA GLP	(16 Pages)
	G2 = FIFRA GLP	(22 Pages)
	G3 = GLP	(7 Pages)
IV	**I = Industry Related Topics**	
	I1 = Technologies for Reducing Dioxin in the Manufacture of Bleached Wood Pulp	(80 Pages)
	I2 = Control and Reduction Chlorinated Organics (Pulp / Paper Industry)	(113 Pages)
	I3 = Lowering Dioxin Formation & Chlorinated Organics During Chemical Pulp Beaching	(11 Pages)

References on Laboratory Accreditation

1. **ASTM E-548**
   ASTM E-548, ASTM PHILADELPHIA, PA 14103
   "Standard Recommended Practice for Generic Criteria for Use in Evaluation of Testing and/or Inspection Agencies"

2. **ASTM D-3856**
   ASTM D-3856, ASTM PHILADELPHIA, PA 14103
   "Evaluating Laboratories Engaged in Sampling and Analysis of Water and Waste Water".

3. **ISO GUIDE 25**, "Guidelines for Assessing the Technical Competence of Testing Laboratories", American National Standards Institute, 1430 Broadway, NY, NY 10018.

4. **ISO 9000**

Sound Management Techniques for Environmental Chemical Analysis Laboratories

Yves Tondeur, Ph. D.
Triangle Laboratories, Inc.

Outline

1. Application of Chemical Analysis
2. Environmental Testing (regulations)
3. Legal Implications of Laboratory Data
4. Organization of Analytical Activities
5. Laboratory Layout
6. Staffing Considerations
7. Safety Considerations
8. Sample Handling/Reporting Practices
9. Production Management
10. Quality Assurance
11. Customers
12. Budgeting
13. Project Costing

Applications of Chemical Analysis

Industry:

Quality Control, Quality Assurance, Process Control, Problem Solving, Technical Services

Legal:

Patents, Forensic, Technical Basis for Regulation Action, Compliance with Government Regulations (Environmental, Hygiene, Toxicology, Food & Drug)

R & D Assistance:

Industrial
Governmental
Medical
Biological
Geochemical
Physical

INTRODUCTION

REGULATIONS

CLEAN WATER ACT (CWA)

SAFE DRINKING WATER ACT (SDWA)

FEDERAL INSECTICIDE, FUNGICIDE & RODENTICIDE ACT (FIFRA)

TOXIC SUBSTANCES CONTROL ACT (TSCA)

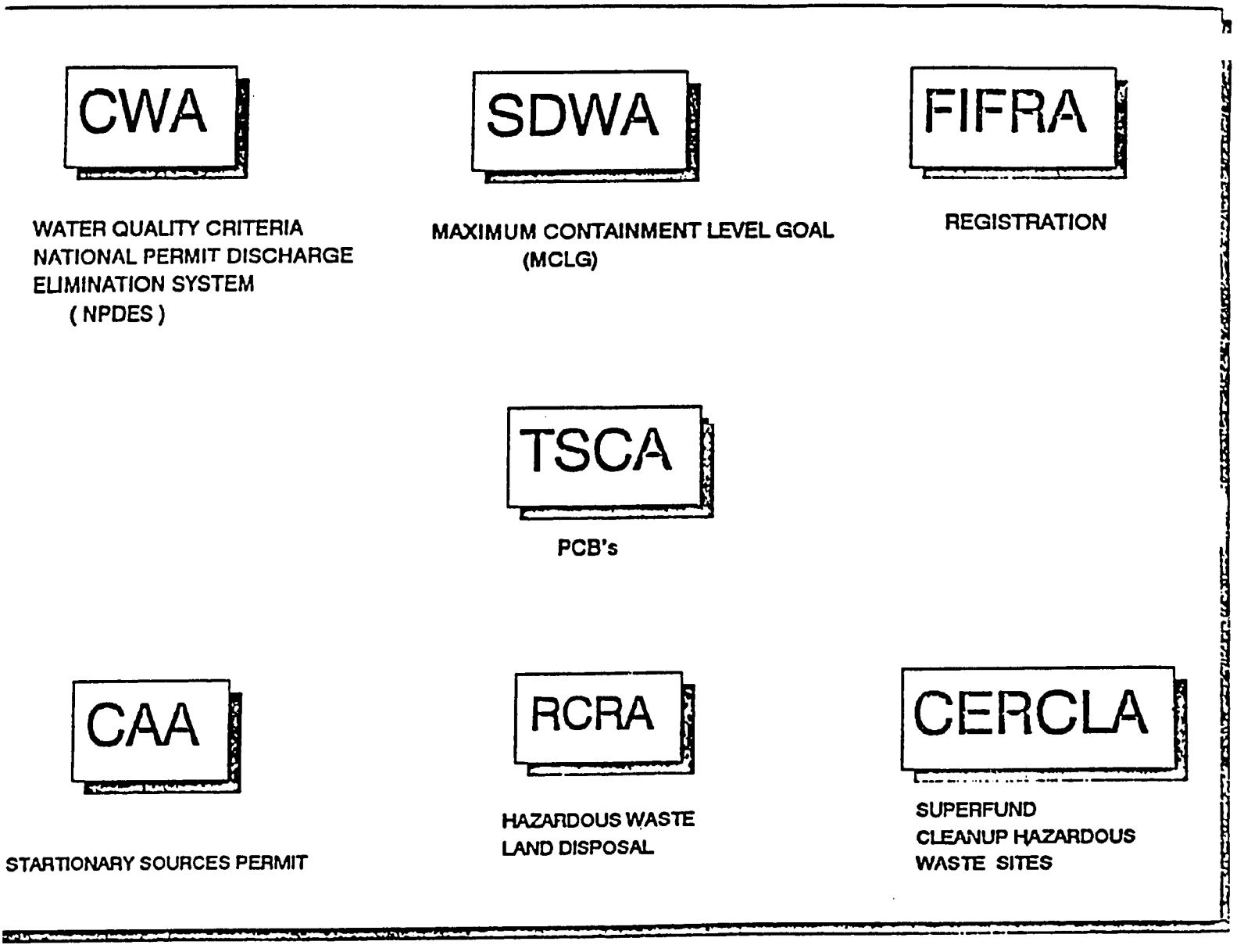
RESOURCE CONSERVATION & RECOVERY ACT (RCRA)

COMPREHENSIVE ENVIRONMENT RESPONSE,
COMPENSATION & LIABILITY ACT (CERCLA)

CLEAN AIR ACT (CAA)

Legal Implications of Laboratory Data

- Court of Law Testimony
  - Contract Disputes
  - Patent Infringement
  - Litigation on Statutory Matters
- Methods Used
- Validity of Evidence
- QC Procedures
- State of Statistical Control of Methods Used
- Calibration
- Experience/Education
- Accountability of Analyses



Organization of Analytical Activities

By:

- ❑ Type of Work
- ❑ Product
- ❑ Analytical Method

Type of Work

- ❑ Routine
- ❑ Non-Routine
- ❑ Special Projects
- ❑ Research and Development

Pros

Utilize Individual Talents
Cross Training (shifting staff, workload variations)
Personnel Development
Economy of Scale (routine analyses)

Cons

Difficulty in Setting Priorities
Difficulty in Cost Accounting

Analytical Methods

- ❑ 8290, 1613, 23, 8280 for PCDD/PCDFs
- ❑ 8240, 624, 1624 for VOA
- ❑ 8270, 625. 1625 for SVOA

Pros

Avoid Duplication
OFI (At the Method Level)
Staff Expertise
Cost Accounting

Cons

Narrow Field of Specialization
Routine and Non-Routine Analyses Priorities

Product Lines

- ❑ CAA
- ❑ CWA
- ❑ RCRA
- ❑ TSCA/FIFRA
- ❑ Others

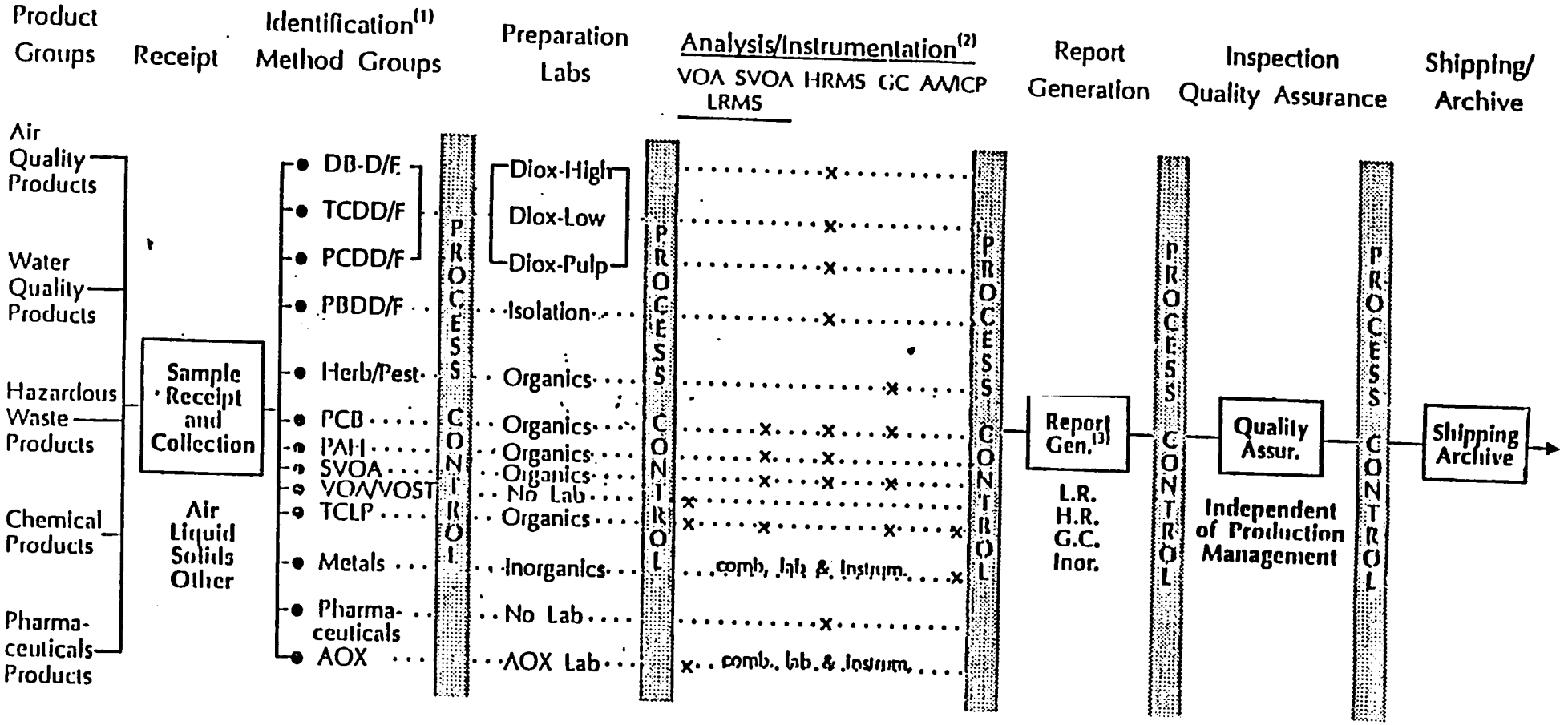
Pros

Cost Accounting
Setting Priorities
Team
Opportunities for Improvement (OFI)
(Recognition and Implementation)

Cons

Duplicaiton of Testings and Instrumentation
Less Flexible Cross-Training

TRIANGLE LABORATORIES/RTP
Production Process
Work Flow Diagram



Abbreviations:

(1) DB-D/F--Dibenzo-p-dioxin, Dibenzofuran; TCDD/F--Tetrachlorinated Dibenzo-p-dioxins, dibenzofurans; PCDD/F--Polychlorinated Dibenzo-p-dioxins/Dibenzofurans; PBDD/F--Polybrominated Dibenzo-p-dioxins/Dibenzofurans; PCB--Polychlorinated biphenyls; PAH--Polynuclear Aromatic Hydrocarbons; SVOA--Semi Volatile Organic Analysis; VOA/VOST--Volatile Organic Analysis/Volatile Organic Sampling Train; TCLP--Toxicity Characteristic Leaching Procedure; AOX--Adsorbable Organic Halides.

(2) LRMS, HRMS--Low and High Resolution Mass Spectrometry; VOA and SVOA--Volatile and Semi Volatile Organic Analysis; GC--Gas Chromatography; AA and ICP--Atomic Absorption and Inductively Coupled Plasma Spectrometry.

(3) L.R.--Low Resolution; H.R.--High Resolution; G.C.--Gas Chromotography; Inor.--Inorganics

Laboratory Layout

Follow the Sample Flow

Sample Receiving

Sample Storage

Extraction ("Wet Lab")

Fractionation ("Wet Lab")

Instrumentation

Reporting

QAU

Shipping

Archiving (Data, Sample Extracts)

Laboratory Layout

Other Considerations

Supplies Room
Accounting
Administration (personnel...)
Sales/Sales Support
Marketing
Technical Staff

Hoods
Lab Space
Lab Furniture
Offices, Conference/Meeting Rooms, Library
Waste Disposals
Exits/Alternate Exits
Glassware Storage
Cleaning Glassware
Disposal Glassware
Lunch Room

Staffing Considerations

Routine Analyses:

Technicians Supervised by Professional

Non-Routine Analyses:

Bachelor Level Professional

Special Projects

Professional With Degree Level Commensurate With Complexity

R & D:

Professional (BA, BS or Ph.D.)

Recruiting

Sources

Referrals, Advertisement,
Placement Agency..

Review Job Applications/Résumés

Warning signs, References, transcripts...

Interview

Schedule, Key Personnel, Presentation
for Professionals...

Decision

Orientation of New Employee

- ❑ Organizational Chart
- ❑ Safety Policy (first aid, orientation form...)
- ❑ Mission Statement
- ❑ QA Program
- ❑ SOPs
- ❑ Organization of Analytical Activities
- ❑ Introduction to Key Personnel
- ❑ Management Philosophy
- ❑ Job Description
- ❑ Training
- ❑ Performance Appraisal
- ❑ Personnel Development
- ❑ Confidentiality
- ❑ COC
- ❑ GLP
- ❑ Disposal Practices

Safety Orientation

Safety Orientation Form

- ❑ Philosophy
- ❑ Manual
- ❑ Safety Committee (accident report review and corrective actions)
- ❑ Major Safety Policies (smoking, eye protection, protective clothing, accident reporting, food)
- ❑ Location/Use of Fire Extinguishers, Emergency Showers, Fire Blankets
- ❑ What to do in Case of Fire
- ❑ Where to Obtain Safety Information (e.g., MSDS)
- ❑ Potential Hazardous Conditions
- ❑ Vapors/Fumes
- ❑ Gas Cylinders
- ❑ Undergrounded Equipment
- ❑ Hot Plates/Ovens
- ❑ Broken Glassware
- ❑ Pipetting
- ❑ Good Housekeeping
- ❑ Encourage OFI Safety

Triangle Laboratories, Inc.

Safety

- ❑ Chemical Hygiene Plan
- ❑ Safety and Health Program
- ❑ Exposure Control Plan
- ❑ Hazardous Communication Plan
- ❑ Baseline Annual Physicals
- ❑ Employee Exposure Monitoring Program
- ❑ Occupational Health & Safety Consultants
- ❑ Safety Training-Orientation and Annual

Sample Handling

- ❑ Preservation
- ❑ Transportation
- ❑ Inspection
- ❑ Representativeness
- ❑ Tracking
- ❑ Holding Time
- ❑ Documentation
- ❑ Observation
- ❑ Cross Contamination
- ❑ Switching
- ❑ Fortification
- ❑ Extraction
- ❑ Fractionation
- ❑ Concentration
- ❑ Analysis
- ❑ Audit and QA/QC Samples
- ❑ Archive
- ❑ Disposal/Return

Take a Proper Sample

Identify It Clearly

Protect It from Change

Maintain ID During All

Analyst Processing,

Data Acquisition,

Calculation,

Data Assembly

and

Report Preparation.

Triangle Laboratories, Inc.

Waste

Resource Conservation and Recovery Act (RCRA)

All Wastes Currently Incinerated

All Samples Disposed of per Regulation

Generated Wastes Disposed of in 30 Days

Employee Waste Handling Training

EPA ID# NCD 982156879

Reporting of Results

Modes

A) Telephone
Verbal Report for Urgent Cases;
Special Dispositions

B) Facsimile

C) Hard Copy Report
Results, Supporting Documentation, Raw Data, Calibration, System Performance Data, Calculations, S/N, COC, Sample Tracking and Management forms

Reporting of Results

Considerations

A) Preliminary Versus Final Results

B) Confidentiality

C) Independent Laboratory Status

D) Sample Information Header

E) Records Retention/Storage

TRIANGLE LABORATORIES OF RTP, INC.
1613A PCDD/PCDF ANALYSIS (c)

FILE NAME.: T143201
PROJECT...: 90000
CLIENT PROJECT: n/a
TLI ID....: OPR
COLLECTED.: n/a
RECEIVED..: 03/23/93
MATRIX....: AQUEOUS
EXT. SIZE.: 1.000 L
ADJ. SIZE.: 1.000 L
EXT. DATE.: 03/24/93
EXT. VOL..: 20.00 ul
SPIKE FILE: SP161V2S
INJECT VOL: 2.0 ul

SAMPLE ID.: OPR-HPLC WATER
CLIENT NAME...: TRIANGLE LABORATORIES OF RTP, INC.

ANALYSIS DATE.: 04/07/93
ANALYSIS TIME.: 17:28
ANALYST.....: MC
INSTRUMENT....: T
GC COLUMN.....: DB-5
GC COLUMN ID..: 2701233
ICAL NAME.....: TD54053
ICAL DATE.....: 04/05/93
CONCAL NAME...: T143102
CONCAL DATE...: 04/07/93

CLIENT CODE..: TLI01
DILUTION.....: n/a
BLANK FILE...: T143202
% LIPID.....: n/a
% SOLIDS.....: 0.0
% MOISTURE...: 0.0
ORIGIN.....: n/a
CONTRACT.....: n/a
SAS NUMBER...: n/a
EPISODE.....: n/a

NAME	CONC(PG/L)	NUMBER	DL	RATIO	RRT	FLAGS
2378-TCDD	188			0.77	1.000	___
12378-PeCDD	959			1.57	1.001	___
123478-HxCDD	888			1.24	1.000	___
123678-HxCDD	905			1.23	1.000	___
123789-HxCDD	927			1.23	0.000	___
1234678-HpCDD	912			1.02	1.000	___
OCDD	2070			0.84	1.000	___
2378-TCDF	185			0.72	1.001	___
12378-PeCDF	907			1.57	1.001	___
23478-PeCDF	920			1.57	1.001	___
123478-HxCDF	816			1.15	1.000	___
123678-HxCDF	807			1.16	1.000	___
234678-HxCDF	795			1.16	1.000	___
123789-HxCDF	820			1.16	1.000	___
1234678-HpCDF	824			0.99	1.000	___
1234789-HpCDF	884			0.96	1.000	___
OCDF	1440			0.90	1.005	___
TOTAL TCDD	188	1		0.77		___
TOTAL PeCDD	959	1		1.57		___
TOTAL HxCDD	2740	3		1.23		___
TOTAL HpCDD	934	3		1.09		___
TOTAL TCDF	192	5		0.75		___
TOTAL PeCDF	2440	6		1.55		___
TOTAL HxCDF	4240	7		1.19		___
TOTAL HpCDF	1880	3		0.99		___

Reviewed By: |_____ __/__/__|

161V_RPT 4.07, LARS 5.05.03

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Production Management

A) Scheduling Analyses

- ❑ Customer Needs (Type of Analysis, Report, TAT, QA/QC)
- ❑ Batching (Efficiency, Quality, Cost, Risk Factors)
- ❑ Resources (Personnel, Equipment)
- ❑ Routine vs. Non-Routine Projects (Definition Communication, Project Manager)
- ❑ Relevancy of Test
- ❑ Method Modifications (Sample Complexity, Authority, Impact on TAT)
- ❑ Fast-Turn Around Samples (Rush, Overtime, Disruption of Routine Operation)
- ❑ Holding Time Considerations
- ❑ Sample Processing Progress Report/Status

Triangle Laboratories, Inc.

Equipment List

	# of
High Resolution GC/MS	7
Low Resolution GC/MS	7
Gas Chromatograph	8
Plasma Spectrometer	1
AA Spectrometer	1
Organic Halide Analyzer	1
Autosampler	20

Production Management

B) Managing Backlog

- ❑ Flexible Manpower (pt, temp...)
- ❑ Overtime
- ❑ Training/Cross training
- ❑ Lead Time
- ❑ Use Outside Laboratory
- ❑ Relevancy of Work
- ❑ New Methods Development
- ❑ Working Smarter

Production Management

C) Use of Outside Laboratory

- ❑ Evaluation
- ❑ Audit (facilities, staff/ instrumentation capabilities)
- ❑ Liabilities
- ❑ SOP
- ❑ QA Program
- ❑ Safety Program
- ❑ Housekeeping
- ❑ GLP
- ❑ Reporting
- ❑ PE Samples (assess Accuracy, Precision)
- ❑ Accounting

Quality Assurance

Lab is Expected

to be Able to

Specify the Quality

of its Data in

Quantitative Terms

QA Program

- ❑ Professional Pride
- ❑ Risk of Being Wrong
- ❑ Adverse Actions
- ❑ Malpractice
- ❑ Federal Regulations

Who Does What

Management

- ❑ Decision to go QA
- ❑ Define Quality as a Management Style
- ❑ Commit Resources
- ❑ Designates Leader
- ❑ Approve Appropriate Steps

Who Does What

Leader (QA Manager)

- ❑ Develop Plans
- ❑ Get Cooperation
- ❑ Get Involvement
- ❑ Get Concensus Approval

Triangle Laboratories, Inc.

Quality Assurance Unit

- Independent of Production; Reports Directly to the President
- System of Checks and Balances Outlined in QA Manual and QA Plan

Triangle Laboratories, Inc

Quality Assurance Tools

Quality Assessment

PE Samples

Audits

Statistical Analysis

Control Charts

Reference Materials

Corrective Action

Interlab Studies

Intralab Studies

Quality Control

Education/Training

SOPs

Instrument Calibration

Instrument Maintenance

GLP

QC Guidelists

Who Does What

Staff

- ❑ Provides Expertise
- ❑ Technical Advise/Guidance
- ❑ Writes/Reviews Appropriate Plans

QA/QC Responsibilities

Top Management
- ❑ Policy
- ❑ Climate
- ❑ Resources

Middle Management
- ❑ Guidance
- ❑ Direction
- ❑ Supervision

Staff
- ❑ Quality of Outputs
- ❑ Technical Competence

QA Manager
(Independently Reporting to Pres/CEO)
- ❑ Consultation
- ❑ Advise
- ❑ Oversight

QA Program Outline

1 - Policy
- Dedication to Quality Outputs
- Commitment of Adequate Resources

2 - Purpose
- To Satisfy Concerns of Customers
- To Infom on QA Aspects
- To Define Each Employee's Role

3 - General Aspects
- SOPs
- GLP
- Safe Practices
- Safe Disposal
- Planning
- Experimentation

QA Program Outline

4 - Sampling

5 - Analytical Methodologies
Selection
Written Procedures
Recommended SOPs for Recurring Steps
Calibration
Maintenance
Data Processing
DQO

6 - Laboratory Records
Documentation

7 - Control Charts

QA Program Outline

8 - Quality Assessment
- Validation
- Precision - Replicates
- Accuracy - Spikes/Surrogates
- PE Samples
- Multiple Techniques

9 - Data Reporting/Review
- Policy
- Contents
- Release

[redacted] - Implementation
- Responsibilities

Customers

- Difference Between What Customer Wants and What Customer May Need
- Switch From a Customer Asking to Run a Sample to a Customer Asking to Solve a Problem
- Decision on Method, Precision, Accuracy and Cost

Aim of Laboratory

Provide Service of

Greater Value by

Increasing Benefits,

Lowering Costs

or Both.

$$\text{Value} = \frac{\text{Benefits}}{\text{Cost}}$$

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Aim of Customer

Determine If

Benefits Received

For Cost

Incurred

Will Yield

Desired Value

Method Selection

Internal Methods

Special Applications

Adaptation of Existing Outside Sources Methods

Outside Sources Methods

- ASTM, DIN (German Standards Institute) British Standards, AOAC)
- Trade Associations (API, TAPPI)
- Government Agencies (EPA, NIOSH, DOE)
- Published Compendia (IARC)
- Journals (Analytical Chemsitry)
- Suppliers
- Customers

Increasing Value

Discuss with Customer the Problem and Purpose of Analysis

Publicize Test Information and Costs

Encourage Batching

Encourage Customers to Cancel Incompleted Analyses When No Longer Relevant

Statistical Evaluation of Lab Capabilities to Perform Adequately

Users' Manual

- ❑ Prepared by a Professional Reponsible For It
- ❑ Informative Title
- ❑ Method Name
- ❑ Adoption Date
- ❑ Scope
- ❑ Summary/Outline
- ❑ Procedure
- ❑ Calculations
- ❑ Reporting
- ❑ Calibration Criteria
- ❑ DQO
- ❑ Tables/Figures
- ❑ Data Qualifiers

You Have a

Problem

If an Outsider

Tells You That

You Have a

Quality Problem

QC Charts

- Variation Occurs in All Measurement Systems

- When Only Chance Causes of Variation are Present, the Pattern is Stable and Predictable (Statistical Control, Statistical Laws Apply)

- Non-Random Variability (Assignable Cause) Suggested by:
  - One or More Points Beyond CL
  - One or More Points Close to CL
  - 5 Consecutive Points < or >
  - A Run of 7 Points Either Above or Below the Mean (Even If They Are Within CL)
  - Drastic Fluctuations

Maintenance and Calibration

- ❑ Assign Responsibility
- ❑ Maintenance Contracts
- ❑ In-House Engineers
- ❑ Record Dates
  - Inspection
  - Calibration
  - Nature of Adjustment
- ❑ Calibration
  - Initial Calibration
  - Continuing Calibration
- ❑ SOPs

Standard Solutions

- ❑ Assign Responsibility
- ❑ Check Periodically
- ❑ Expiration Date
- ❑ Inventory Management
- ❑ Storage Conditions
- ❑ SOPs
- ❑ Calibration (Balance)
- ❑ Dilution Procedures
- ❑ Training

Good Laboratory Practices

Purpose

- ❑ To Help Generate Good Data
- ❑ To Create a Credible Final Report
- ❑ To Convince Final Report Readers That Data are What the Report Says They are

Bonus

Lower Operating Costs by Increasing Efficiency

Good Data

- ❑ Ensuring Integrity of Samples, Standards and Reagents
- ❑ Proper Initial Documentation of Identity and Purity
- ❑ Avoids Unrecognized Deterioration Due to Improper Storage
- ❑ Sample Chain-of-Custody
- ❑ Standards Verification
- ❑ Standards and Reagents Purity
- ❑ Avoids Out-Of-Date Standards and Reagents

Good Data

- ❑ Eliminates Procedural Mistakes Through SOPs and Better Communication
- ❑ Customer and Regulatory Agency Knows Beforehand What is Supposed to be Done
- ❑ Management Communicates Clearly What is to be Done
- ❑ Personnel Know What to Do
- ❑ Management Knows What Was Actually Done
- ❑ Client and Regulatory Agency Know Afterward What was Actually Done

Credibility

GLP Enables Report Readers and Auditors to Confirm Data Quality

- ❑ What Did the Lab Do?
  (Protocol, SOPs, Initials/Signatures, Description of Activities)

- ❑ Was What the Lab Did Correct?
  (What the Customer/Agency Wanted?, Protocol Approval Documents)

- ❑ What Were the Results?
  (Data is Present, Complete and Signed)

- ❑ Were the Calulations Correct?
  (Sufficient Data Presented so Calculations can be Verified with No Help From the Lab.)

- ❑ Did Personnel Who Did the Work Know What They Were Doing?
  (Training Records, Personnel Qualifications)

- ❑ All Relevant Facts About an Analysis Must Reside in a Location Easily Accessible

- ❑ Facts Accurately and Completely Recorded

- ❑ Safeguard the Information in a Proper Archive

Triangle Laboratories, Inc.

Good Laboratory Practices

- GLP-USEPA and FDA Set of Regulations Designed to Ensure Consistent Quality
- QAU Inspection to Verify Compliance

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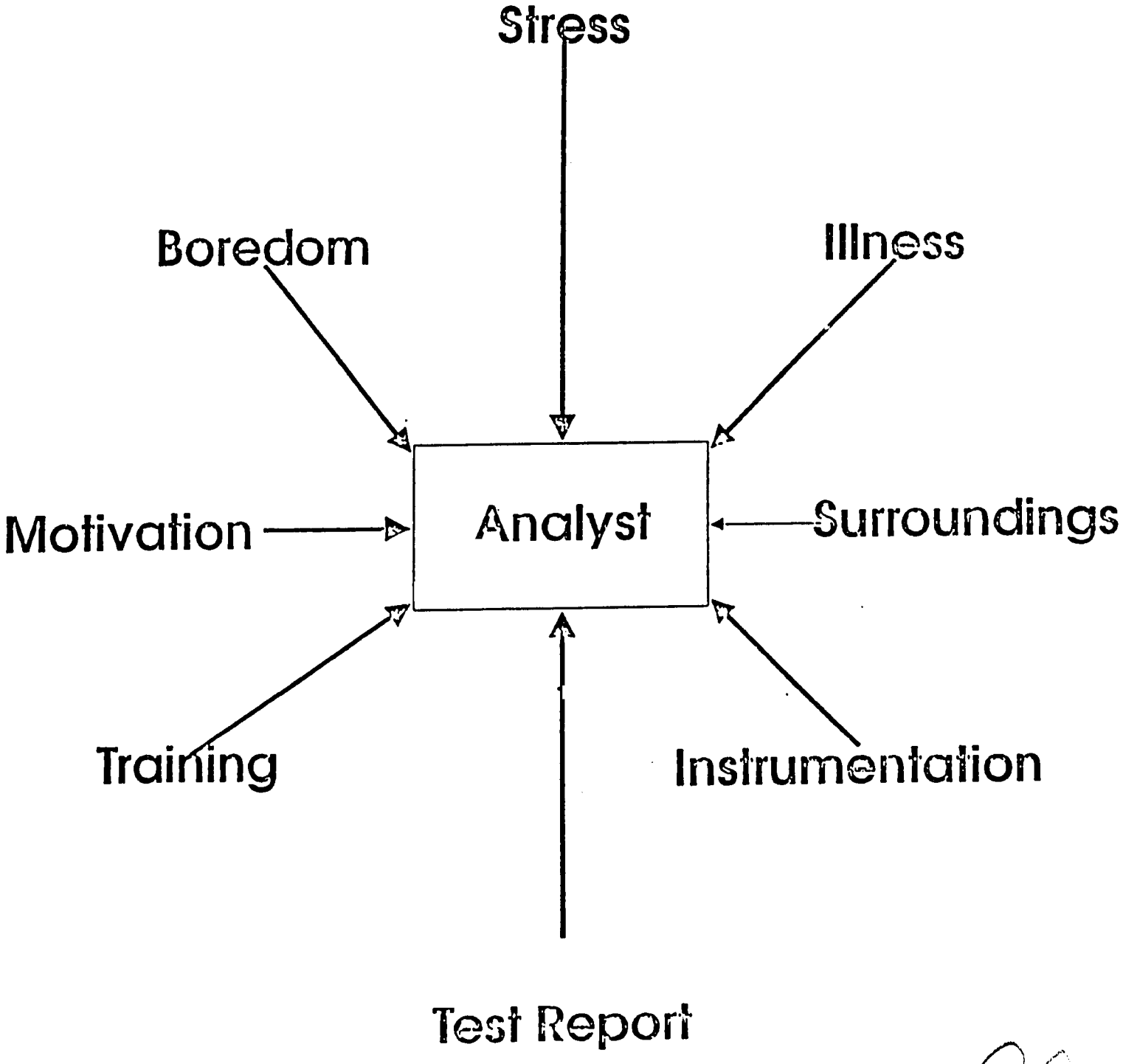
What Influences the Analyst



Cost/Benefits of QA

Costs

Direct
- ❑ Test Materials
- ❑ Standards
- ❑ Performance Evaluation Sample Analyses
- ❑ Labor (Personnel/Supervision)
- ❑ QA Manager
- ❑ Round-Robin Studies
- ❑ Audits
- ❑ Travel/Meetings/Classes

Indirect
- ❑ Extra Cost for Quality People
- ❑ Extra Cost for Quality Equipment
- ❑ Extra Cost for Quality Supplies
- ❑ Relaxed Work Schedules
- ❑ Training

Benefits

- ❑ More Efficient Outputs
- ❑ Less Rework
- ❑ Greater Confidence

  (Customer, Lab, Staff)

Lab Certification/ Accreditation

Benefits

- ❑ increased Confidence/Acceptance
- ❑ Identification of Competent Labs
- ❑ Focus on Good Practices

Disadvantages

- ❑ Slow Down and Discourage Innovation and Initiative
- ❑ Retards/Freezes Technology
- ❑ Costs (Fees, Administration, On-Site Audits Proficiency Testing)

Accreditation

Organization
- Duties/Responsibilities Defined
- Supervision/Inspection/Self-Audit

Staff
- Technical Competence
- Qualification Documented
- Training/Maintenance of Competence
- Sufficient Supervision
- Adequate Support

Equipment
- Adequate Kind and Quality
- Maintenance

Accreditation

Calibration/Reference Standards

Test Methods/SOPs/COC

Environment
- Space
- House Keeping
- Chemical Control
- Physical Control

Storage

Records

Reports

QA Program

Triangle Laboratories, Inc.

List of Certification and Accrediations

New York State Dept. of Health

American Assoc. for
Laboratory Accreditation

South Carolina Dept. of
Health & Environmental Control

State of Washington, Dept. of Ecology

State of Wisconsin,
Dept. of Natural Resources

State of Utah,
Dept. of Health

Triangle Laboratories, Inc.

Current Performance Evaluation Studies

USEPA Atmospheric Research and Exposure Laboratory Study - Blind Sample for Dioxin/Furan Study.

Ontario Ministry of the Environment - Participant in Round Robin Study for Dioxin/Furan in Ambient Air.

USEPA - Round Robin Study for Method 1613 Validation.

Triangle Laboratories, Inc.

Current Performance Evaluation Studies

State of New York - Semiannual PE studies covering Organic Purgeable Aromatics, Purgeable Hydrocarbons, Haloethers, Priority Pollutant Phenols, Phthalate Esters, Polychlorinated Biphenyls, Chlorinated Hydrocarbon Pesticides and Dioxins in water and Priority Pollutant Phenols in solid waste.

USEPA Water Pollution Studies - Semiannual studies for Organic Volatile Armoatics, Halocarbons, Pesticides and PCBs in water and PCBs in oil.

Analytical Report

- ❑ Title
- ❑ Customer ID
- ❑ Case Narrative
- ❑ Objectives
- ❑ Sample Identification, History
- ❑ Procedure
- ❑ Data and Summary
- ❑ Interpretation
- ❑ Recommendation
- ❑ Attestation

ACS Guildelines for Data Acquisition and Data Quality Evaluation in Environmental Chemistry

- Well-Designed, Carefully Executed Measurement Process
- Use of Sensitive, Specific, Validated Measurement Methods
- Use of Reliable Protocol for
  - Sampling
  - Measurement
- Use of QA Procedures
  - Demonstration of Statisical
  - Control via QC Charts

ACS Guidelines

- Validation of
  - Samples (admit as a member of population under study, authenticity)
  - Measurements/Data
- Assignment of Uncertainties to Data
- Specifics
  - LOD
  - LOQ
  - Confirmation
  - Recovery
  - Reference Materials

Other Considerations

- Budgeting (Expense/Capital)
- Project Costing
- Cost Control of Supplies and Materials
- Capital Investments (Selection)
  - What You Want
  - Specs
  - Test with Samples
  - Users' List
  - Performance
  - Service/Parts
  - Delivery
- Professional Relationships
  - Publications
  - Presentations
  - Client Relations (Problem Solving)

Appendix G

Curriculum Vitae

21 June 1993

CURRICULUM VITAE

YVES GILBERT NORBERT MARIE-GHISLAIN TONDEUR

Primary Responsibilities/Expertise
Management/Supervisory Experience
Dioxin Trace Analysis Expert
HRGC/HRMS Expert

EDUCATION:

Postdoctoral Fellow, National Institute of Environmental Health Sciences, Research Triangle Park, NC, 1980-82

Postdoctoral Fellow, Florida State University, 1979-80

Ph.D., Free University of Brussels, 1979

M.S., Free University of Brussels, 1974

OTHER

"Executive Development Program", Drake Beam Morin, Inc., Raleigh, NC; December 1992 - Present. ("INTJ")

"Assertive Management", College of Business and Economics, University of Nevada, Las Vegas, NV; January 1987.

"Quality Assurance of Chemical Measurements", American Chemical Society Short-course, St Louis, Missouri; 26-27 September 1986.

"How to Supervise People", National Seminars, Inc., Las Vegas, NV, February 1986

"How to Write Better Technical Reports, Proposals and Papers", University of Nevada-Las Vegas, Las Vegas, NV, February 1986

"Ion Optics", ASMS Short Courses, San Diego, CA, May 1985

"ZAB-3F Maintenance", Manchester, England, June 1985

"Improved Management of the Chemical Analysis Laboratory" McGraw Hill Seminars, Boston, MA, December 1985

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PROFESSIONAL EXPERIENCE:

December 1, 1992 to Present:

Corporate Vice President, Technology, Triangle Laboratories, Inc.

Primary duties include consultation with government and industry users of analytical services to enhance Triangle Laboratories mix of products and participate in the design and development of innovative analytical technologies to meet the customers' needs for quality, variety, customization, convenience, timeliness and cost specifications.

Participate in Triangle Laboratories strategic planning efforts and new business development activities. Made a decision to move away from direct involvement in operation and production affairs to experience a broader picture of the business, workplace and market environment trends.

January 1, 1992 to December,1 1992:

President & CEO, Triangle Laboratories of RTP, Inc. Responsible for the day-to-day operation of the facilities located in the Research Triangle Park, NC (180 employees).

October 1, 1990 to December 31, 1991:

Executive Vice President, Triangle Laboratories, Inc., Research Triangle Park, NC. Responsible for the day-to-day operation of the facilities located in North Carolina (146 employees).

Introduced an inorganic analyses product line and developed new procedures for the analysis of samples for PCDD/PCDFs that resulted in improving the quality of the analyses, the responsiveness (the turn-around time dropped from 45-60 days to less than 21 days during peak periods and 10-14 days in normal backlog periods) and reducing costs at a time when prices depreciated due to the increased competition.

October 1, 1989 to September 30, 1990:

Vice President, Environmental Chemistry, Triangle Laboratories, Inc., Research Triangle Park, NC. Managed two divisions of professionals and technicians providing environmental analyses for trace levels of "dioxins" and organic pollutants to Industrial clients, State and Federal Agencies.

Conducted a $3^{1/2}$ year research and method development program for the Brominated Flame Retardant Industry Panel (BFRIP) that lead to the approval by the EPA Office of Toxic Substances of five TSCA-compliant analytical protocols for the determination of parts per trillion levels of polybromi-

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nated dibenzo-p-dioxins and dibenzofurans in flame retardant chemicals (polybrominated diphenyloxides and derivatives). Other methods include analytical protocols for PAHs and PCBs using isotope-dilution HRGC-HRMS.

April 1987 to September 1989:

Senior Scientist, Triangle Laboratories, Inc., Research Triangle Park, NC. Dioxin Division Director, responsible for organizing, scheduling, directing and controlling all aspects of production of dioxin-related analyses. Other responsibilities include interaction with costumers and development of new methodologies . Supervisory responsibility for over 55 chemists.

Developed and implemented modifications of EPA Method 8290 (e.g., 8290E & 8290X) to allow the analysis of matrices (e.g., Modified Method 5 stack sampling trains) not currently covered by Method 8290. These modifications and QA improvements have been the basis for the development and promulgation by EPA of new methods such as EPA Methods 1613 and 23 and California Air Resources Board (CARB) Method 428 for PCDD/PCDFs.

December 1984 to April 1987:

Chemist, Quality Assurance Laboratory, Environmental Research Center, University of Nevada-Las Vegas, Las Vegas, NV.

Project leader for the combined high - resolution gas chromatographic and high-resolution mass spectrometric (HRGC/HRMS) analysis of parts per-trillion level of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and total TCDD in environmental media. Responsible for the supervision of the high-resolution mass spectrometry laboratory, operation and maintenance of the triple-sector high-resolution ZAB-3F mass spectrometer and the preparation of samples related to the HRGC/HRMS program.

Developed and organized a research unit capable of supporting the EPA Superfund Program for the determination of ppt levels of chlorinated dibenzodioxins and dibenzofurans. Developed several standards operating procedures (SOPs). Provided technical support to implementation of the HRGC/HRMS EPA Dioxin Analytical Protocols by writing the protocols (High - Resolution GC/MS Analysis for 2,3,7,8 - TCDD and Total TCDDs in water, soil and sediment"; "Method 8290"), actively participated in caucus planning meetings, provided technical consultative support to Environmental Monitoring System Laboratory - Las Vegas and EPA Region VII, provided on-site audit support, and interpreted results from single laboratory evaluations of new methods, as well as participated directly in single - laboratory evaluations.

Participated as a Quality Assurance Evaluator in the EPA audit of two Contract Laboratory Program (CLP) laboratories.

Lectured at the University at Nevada, Las Vegas (UNLV) Chemistry Department (Fundamentals of Organic Mass Spectrometry; 6 sessions).

Analyzed numerous standard solutions supplied by the EPA Quality Assurance Bank (QAMB) to verify their accuracy and stability for protocol support.

Reviewed, at EPA request, several special Analytical Service data packages and commented on the validity of the conclusions drawn in associated reports.

Supervisory responsibility for four analytical chemists and two student trainees.

February 1982 to December 1984:

Scientist, responsible for the supervision, operation and maintenance of the mass spectrometry facility at the National Cancer Institute, Frederick Cancer Research Facility.

This position combined self-initiated research, collaborative and support projects.

The facility was equipped with a reverse-geometry VG ZAB-2F high-resolution GC/MS/DS (VG 2035 Data System), a Finnigan 3200 GC/MS/DS and a triple-sector mass spectrometer VG 7070 EQ GC/MS/DS (VG 11/250 Data System).

Experience in high-resolution mass spectrometry, HRGC-HRMS, accurate mass measurements, Chemical Ionization, Desorption Chemical Ionization, Field Desorption, Fast Atom Bombardment, tandem mass spectrometry (MIKES, CAD, LINKED- SCANS, MS/MS with hybrid instrument having an EBQQ configuration), Selected Ion Monitoring, and Qualitative and Quantitative analyses.

Examples of chemicals identified or structures confirmed by MS are nucleoside adducts, amino acids, dipeptides, oligopeptides, fermentation isolates, anti-tumor antibiotics, chemotherapy drugs and their metabolites, PAH metabolites, nitrosamine metabolites, steroids, synthesized chemicals, $^{15}N2$, deuterium incorporation in methanol using high-resolution mass spectrometry.

Over 2,000 mass spectrometric analyses were performed during the period covering February 1982 - January 1983.

Supervisory responsibility for two technicians.

January 1980 to February 1982:

Postdoctoral Visiting-fellow at the National Institute of Environmental Health Sciences, Research Triangle Park, NC.

Participated in a research program for the development of trace organic analytical methods using positive and negative ion chemical ionization, high-resolution selected ion monitoring (peak profile mode of acquisition), and Mass- analyzed Ion Kinetic Energy Spectrometry (MIKES). The specific research involved a detailed study of extraction/clean-up procedures to identify chemicals being carried along and then determine the degree to which they act as an interference when the above mentioned mass spectrometric techniques are used in the measurement step (2,3,7,8-tetrachlorodibenzo-p-dioxin, PCB's, PBB's).

A method based on kinetic-energy release measurements was developed for the structural determination of brominated (10-9g) compounds by GC-MS/MS.

Experience in operation of a ZAB-2F interfaced to an INCOS 2300 Data System (Finnigan) and an HP 5700 Gas Chromatograph; Finnigan 3300 modified for Negative Chemical Ionization operation and direct liquid LC; 7070-VG Analytical coupled to a VG 2050 Data System and HP 5700 GC.

February 1979 to January 1980:

Postdoctoral Research Associate at the Florida State University, Tallahassee, FL where new methods were developed for detecting toxic substances (e.g., tetrachlorinated dibenzodioxins) in the environment through the use of Negative Chemical Ionization Mass Spectrometry. Acquired experience in trace analysis (extraction, clean-up procedures) and operation of a MS 902-mass spectrometer.

July 1974 to February 1979:

Preparation of a dissertation at the Universite Libre de Bruxelles (Belgium) during which we studied the configurational stability of organotin compounds using Nuclear Magnetic Resonance Spectroscopy (Bruker 270 mHz). Stereochemical stability upon NMR time scale was established for triorganotin hydrides, hexa-organoditin, triorganostannyl-amine, -phosphine, and -arsine. We synthesized, for the first time (more than 70 years after the first reported trials), optically active triorganotin- hydrides, -halide and hexa-organoditin, and we studied the stereochemistry of the substitution reaction at the chiral tin center.

As part of the program requirements, we prepared and defended an annex thesis entitled: "The Preparation of a New Kind of Paramagnetic Complexes and a More Detailed Study of the Complexation Equilibria May Lead to an Improved and Effi-

cient Method to Determine the Optical Purity", we studied NMR applications in organic chemistry, group theory and representation theory, kinetics in organic chemistry, chemical oceanography, Industrial Chemistry and Pollution, and photoconversion of solar energy. We acquired experience in organic and organometallic synthesis (handling of air and light sensitive compounds), spectroscopic analysis (NMR, IR, MS, ORD). Organization of research projects for several undergraduate and graduate students.

August 1973:

Research in a pharmaceutical industry laboratory (Union Chimique Belge-UCB), Brussels (Belgium).

PROFESSIONAL AFFILIATIONS:

American Chemical Society

American Society for Mass Spectrometry

Union des Anciens Etudiants De L' Universite Libre de Bruxelles

Source Evaluation Society

American Society for Mechanical Engineers (PTC 45 Committee Member)

Air & Waste Management Association

PUBLICATIONS AND PRESENTATIONS:

PUBLICATIONS

M. Gielen, S. Simon, Y. Tondeur, M. Van de Steen and C. Hoogzand, "Three New Classes of Configurationally Stable Organotin Compounds." Bull. Soc. Chim. Belges 83:337-338, 1974.

Yves Tondeur, "Stabilite Optique d'Hydrure Organostanniques", Thesis, Universite Libre de Bruxelles, Bruxelles, July 1974.

M. Gielen and Y. Tondeur, "Configurational Stability of Triorganostannylamines, -phosphines and -arsines." Bull. Soc. Chim. Belges 84:933-938, 1975.

M. Gielen, C. Hoogzand, S. Simon, Y. Tondeur, I. Van den Eynde and M. Van de Steen, "The Optical Stability of Organotin Compounds." In J. J. Zuckerman, ed., Advances in Chemistry Series Organotin Compounds; New Chemistry and Applications, Vol. 157:249-257, 1976.

M. Gielen and Y. Tondeur, "Synthesis and Optical Stability of Chiral Triorganotin Hydrides." J. Organometal. Chem. 127:C75-C77, 1977.

M. Gielen and Y. Tondeur, "Stereoselective Transformations of the Optically Active Triorganotin Hydrides into Optically Active Tetraorganotin Compounds." J. Organometal. Chem. 128:C25-C26, 1977.

M. Gielen, S. Simon, Y. Tondeur, M. Van de Steen, C. Hoogzand, and I. Van den Eynde, "Chiral Organotin Compounds." Israel Journal of Chemistry 15:74-77, 1976-1977.

M. Gielen and Y. Tondeur, "Synthesis of the First Example of an Optically Active Hexaorganoditin." J. Chem. Soc. Chem. Comm. 81-82, 1978.

M. Gielen and Y. Tondeur, "The First Optically Active Triorganotin Halide: A New Stereoselective Reaction of a Triorganotin Hydride." Nouv. J. de Chimie 2:117-118, 1978.

M. Gielen and Y. Tondeur, "Synthesis, Optical Stability, Stereoselective and -specific Reactions of Chiral Triorganotin Hydrides." J. Organometal.Chem. 169:265-281, 1979.

Yves Tondeur, "De l'Etude de la Stabilite Configurationnelle en Resonance Magnetique Nucleaire a la Formation de Composes Organostanniques Chiraux Mono-fonctionnels. Racemisation, Stereoselectivite et Stereochimie au Niveau du Metal des Hydrures de Triorganoetain", Ph.D. Thesis, Universite Libre de Bruxelles, Bruxelles, January 1979.

D. W. Kuehl, R. C. Dougherty, Y. Tondeur, D. L. Stalling, L. M. Smith, and C. Rappe, "Negative Chemical Ionization Studies of Polychlorinated Dibenzo-p-dioxins, Dibenzofurans and Naphthalenes in Environmental Samples." Environ. Health Chem., James D. McKinney, ed., Ann Arbor Science Pub., Inc. Chapter 12, p 245-261, 1980.

Y. Tondeur and R. C. Dougherty, "New Screening Methods for Acidic Toxic Substances using Negative Chemical Ionization Mass Spectrometry: Dacthal in Human Urines." Environ. Sci. Tech. 15:216-219, 1981.

M. Gielen and Y. Tondeur, "Reactions of Racemic Tetraorganotin Compounds with Butyllithium and with Lithiumaluminum Hydride." J. Organometal. Chem. 216:371-376, 1981.

C. E. Parker, R. D. Voyksner, Y. Tondeur, J. Henion, and J. Yinon, "Analysis of Explosives by LC-Negative Chemical Ionization Spectrometry." J. Forensic. Sci. 27:495-505, 1982.

J. R. Hass, Y. Tondeur, and R. D. Voyksner, "Kinetic Energy Release in the Structural Determination of Brominated Compounds by Gas Chromatography/Mass Spectrometry." Anal. Chem. 55:295-297, 1983.

Phillip W. Albro, Yves Tondeur, Dean Marbury, Sandra Jordan, Joanna Schroeder, and Jean T. Corbett, "Polar Metabolites of Di-(2-Ethylhexyl) Phthalate in Rat". Biochem. Biophys. Acta. 760:283-292, 1983.

Yves Tondeur, J. Ronald Hass, Donald J. Harvan, and Phillip W. Albro, "Computer-Assisted Determination of Masses in High-Resolution Mass Spectrometry with Selected Ion Monitoring." Anal. Chem. 56:373-376, 1984.

Yves Tondeur, J. Ronald Hass, Donald J. Harvan, James D. McKinney, and Phillip W. Albro, "Determination of Suspected Toxic Impurities in Firemaster FF-1 or BP-6 by Capillary Gas Chromatography High-Resolution Mass Spectrometry." J. Agr. Food. Chem. 32:406-410, 1984.

Lanny I. Hecker, Yves Tondeur, and James G. Farrelly, "Formation of and r-aminocaproate from N- nitrosohexamethyleneimine: Evidence that microsomal 9- hydroxylation of cyclic nitrosamines may not always involve the insertion of molecular oxygen into the substrate." Chem. Biol. Interactions, 49: 235-248, 1984.

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Dioxin '90, 10th International Symposium on Chlorinated Dioxins and Related Compounds, Bayreuth, FRG, September 10-14, 1990; M.J. Charles, G.D. Marbury, S.A. Guyan, Y. Tondeur; MS/MS in Environmental Analysis: Development and Applications of Methods to Tetrahalogenated Dibenzo-p-Dioxins and Dibenzofurans."

Seventeenth Annual Meeting of the Federation of Analytical Chemistry and Spectroscopy Societies; Cleveland, OH, October 7-12, 1990; Y. Tondeur, "Application of High-Resolution Mass Spectrometry to Environmental Problems."

1990 TAPPI Oxygen Delignification Symposium; Toronto, Ontario, Canada, October 17-19, 1990; Y. Tondeur, T. N. Sorrel; "Issues with Dioxin Analytical Techniques."

Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Chicago, March 4-7, 1991; Invited Speaker: Yves Tondeur, "Ultra-Trace Polybrominated Dibenzo-p-Dioxins and Dibenzofurans in Flame Retardant Chemicals: A New Methodology, Development Challenges and QA Guidelines."

84th Annual Meeting of the AWMA, Vancouver, Canada; June 1991; Hani S. Karam, Edwin A. Marti, Yves Tondeur, J. R. Hass; "Recent Advances in Analytical Procedures for Source Hazardous Air Pollutants".