

## CHENG SHIU UNIVERSITY

## Center for Environmental Toxin & Emerging Contaminants Research

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⑥ 正修科技大學校園配置

# About Us

The Super Micro Mass Research and Technology Center in Cheng Shiu University is the first certified Dioxin Laboratory in Taiwan. After 19 years of stable development, it is now playing a pivotal role as a frontrunner in ensuring domestic safety of the environment and food. In the last decade, the center's total funding from industries, governments, and other academic institutions reached a lump sum of 68 million US dollars.





Furthermore, the center received a follow up funding for the "Global Taiwan Research Center" from the Ministry of Education in 2018. Recently, it was upgraded from "Super Micro Mass Research & Technology Center" to "The Environmental Toxin and Emerging Contaminants Research Center" with about 130 faculty members. This center's key fields of investigations include air, water quality, soil, industrial waste, food, emerging contaminants, drugs, and doping in sports.

## Advanced and Sophisticated Instruments and Equipment

This center possesses laboratories with world-class and cutting edge instruments and equipment with which it provides professional and highly effective chemical analysis services.

- High Resolution Gas Chromatograph Mass Spectrometer (HRGC/MS)
- Stable Isotope Ratio Mass Spectrometer (IRMS)
- Gas Chromatography-Tandem Mass Spectrometry (GC/MS-MS)
- Gas Chromatography-Mass Spectrophotometer (GC/MS)
- Gas Chromatography-Mass Electron Capture Detection (GC/ECD)
- Gas Chromatography-Flame Ionization Detector (GC/FID)
- Liquid Chromatograph-Tandem mass spectrometer (LC/MS-MS)
- High-Performance Liquid Chromatograph (HPLC)
- Inductively Coupled Plasma Mass Spectrometer (ICP/MS)
- Inductively Coupled Plasma Optical Emission Spectrometry (ICP/OES)
- Atomic Absorption Spectroscopy (AA)
- Ion Chromatography (IC)
- Total Organic Carbon Analyzer (TOC)
- Cold Vapor Atomic Fluorescence Spectrometry(CVAFS)



- Dioxin Continuous Automatic Sampling System (AMEA®)
- Soil and water Vapor and Diesel VOC Preconcentrator Systm
- Air quality monitoring vehicle
- PM<sub>2.5</sub> PM<sub>10</sub> TSP Air Sampler
- PS1 High Volume Sampler
- Microbial sampler
- CO<sub>2</sub> Gas Monitor
- Air Sampling Cylinder
- Air Odor Sampler
- Dioxin, Cr6+ and Particulate Sampling System (Flue)
- SO2 NOx CO2 CO O2 Monitor (Flue)
- Total non Methane Hydrocarbons Analyzer
- Deep soil sampler
- Groundwater Sampling System
- Ekman Dredge and Core Sampler
- Seawater 10-in-1 Detector
- Ocean Current Walrus Monitor

Flow Injection Analyzer(FIA)

# **Backgrounds and**

Important past events for Taiwan and the corresponding actions in the CENTER

## **CENTER** 5 CSSM

**1999** The Super Micro Mass Research & **Technology** Center was established.

2000 NIEA Emission Pipe **Dioxin Analyzing Method** 2002 NIEA Certified Emission **Pipe Dioxin Sampling Method** 

#### 1999-2002

Procured 4 HRGC/HRMS

#### 1999-2017

Establish a database of dioxin and establish the concept of environmental forensics.

#### 1999-2019

Comparison of environmental standards for dioxin emission to the international standards of other countries such as Sweden, Norway, and Italy.

## **CENTER**

**2004** Established a dioxin analysis method for blood and plants

2005 Established a Food and **Drug Laboratory** 

2007 NIEA Dioxin

TAF Polybrominated biphenyl, **Polybrominated Diphenyl Ethers Analysis** Certificate Food





2004 Supported the analysis of dioxin in milk.

2005 Assisted in the analysis of dioxin and malachite green in duck eggs and groupers

**2006** Assisted in the analysis of Dioxin in lamb and Nitrofuran residues in hairy crab.

#### Drug

2006 Carried out investigations on Doping in Sports for the National Olympic Team.

2007 Cooperated with Chun-Huei Project for Urine Tests for Drugs in the anti-doping efforts.

## 1999

## **Environment**

**1995** Announcement of Dioxin Emission Standard for municipal solid waste incinerator (MSWI)

2000 Announcement of Dioxin Emission Standardsmall sized waste Incinerator

2001 Announcement of Dioxin Emission Standard for the Arc Furnace in the Steel industry.

**2002** Soil pollution incident at Petroleum the China and Chemical Corporation (Sinopec) in An-Shun Factory.



## 2004

## Environment

2004 published Dioxin discharge criteria for Iron ore sintering

2005 Announcement of Dioxin standard for EAF Dust Blast furnace ironmaking of steel industries

#### 2006

- Announcement of Emission Standards for Stationary Pollution Sources.
- Announcement of Hazardous industrial waste incinerator emission standard.

## Food

#### **2004** Dioxin in cow's milk incident.

**2005** Dioxin-containing duck eggs incident in Chang-Hua County: Malachite green residue in Grouper

**2006** Incident of dioxin-contaminated lamb meat in Taipei as well as Nitrofuran residues in Shanghai hairy crab

2007 An Incident of Ractopamine residue in pork imported from the USA

## CENTER

2008-2011 NIEA certified for the analysis of pesticides, Cr6+, CN<sup>-</sup>, TN, Cl<sup>-</sup>, E.coli, and VOCs in water. Pollutants in stack exhaust, and heavy metals from industrial wastes. 2009 **Cross-strait** cooperation for an expedition in the Antarctic with Xue Long.

## Food

2008 Assisted in the Analysis of Melamine in Milk Powder

2005 Started analyzing food and beverage for DEHP which is a toxic plasticizer.

## Drug

- 2010
- Supported Police Units in the drug abuse screening and Confirmation.
- Executed veterinary drug residues test in meat at the ports of entry into the country.

## 2008 Environment

#### 2009

- Announcement of the Dioxin standard for drinking water and mosquito coil.
- An incident of Dioxin contamination in a duck farm at Da Pin Ting, Kaohsiung.

2010 Fire accident and consequent air pollution in Formosa Oil Refinery in Mai-Liao, Yun-Lin.

#### Food 2008

- Incident of Melamine in Milk Powder
- •The incident of Bavistin residue in coconuts imported from Thailand.

**2011** An incident whereby DEHP which is a toxic plasticizer was added to food and beverage.

# Critical events for environment protection and food safety

# **Past Achievement**

## CENTER

#### 2012

#### •NASA 7-SEAS Mission.

• NIEA Certification for detection of PM<sub>2.5</sub> 2015-2016

NIEA certification of VOCs, Dioxins and furans in ambient air、6 pesticide residue in water/drinking water/groundwater and low-frequency noise pollution.

#### **Environment**

**2012**, **2014** Kaohsiung City Government Project for Dioxin and Hazardous air pollutants

**2013** Assisted in the testing of wastewater discharged during the ASE incident in Kaohsiung.

#### Food

**2013** Assisted in the analysis of Maleic Acid in flour.

- 2014
- Assisted in the chemical examination of dried bean curd for Methyl yellow.
- Assisted the government and industries to check the quality of edible oil obtained from gutter oil.

## 2012 Environment

#### 2012

 Announcement of Dioxin standards for Sediments and Effluents

•Announcement of Air Quality Standard for PM<sub>2.5</sub>

**2013** An incident of discharge of wastewater from ASE Kaohsiung which did not conform to the wastewater quality standards

#### Food

#### 2013-2015

- •Two incidents involving poisoned starch produced with Maleic Acid and selling of fake honey.
- Dried bean curd was analyzed for methyl yellow concentration.
- Production of edible oil from gutter oil.
- •Recurrent incidents of bleaching bean sprouts with sodium sulfite.
- Poisoned kelp incident. Famous shop for crispy chicken was mixing salt and pepper powder with Magnesium Carbonate.

## CENTER

#### 2017-2019

NASA

- 2017 CSSM and Chang Gung Hospital collaboration to research on the relationship between environmental ECs and colorectal cancer.
  - 2018 Transformed into "Environmental Toxic and Emerging Contaminant Research Center."
  - 2018 Established a cloud database for emerging contaminants and hazardous pollutants.

• 2019 Selected by Taiwan High Prosecutors Office as the Institute for Class I - IV drug identification.

#### Environment

#### 2018-2019

- Developed 180 testing methods for ECs , environmental pollutants and LC/MS-MS analysis method of NPAHs for pesticide.
- Developed 457 testing methods for emerging contaminants and environmental pollutants..
- Applied advanced testing methods for 20 types of Ecs in 80 drinking water samples for the EPA.
- Established techniques to evaluate large scale steel factory's local pollutant emission coefficient.
- Carried out a diagnosis on the system's efficiency for pollution control in an industrial waste treatment plant.

## Food

2016

**2018** Assisted in the screening of Fipronil in eggs.

## 2020

# Environment

- •2017 Fires in the Federal Corporation tire factory resulted in dioxin emission.
- •2017 First draft of the air pollution standards for stationary sources.
- 2018 The release of air pollutants from raw materials and bituminous coal due to outdoor stacking and the evaluation of indoor material stacking in China Steel Company.

## Food

#### 2016-2018

- 2016 Incident where the concentration of both Escherichia coli and total bacteria count in milk tea from a vendor machine exceeded the set limits.
- 2017 The incident of Dioxin-contaminated eggs.
- •2018 fermented vegetables did not meet the food safety standard.
- •2018 Macaron contained illegal food dye.





## CENTER

2020 May 2020, received approval from the Ministry of Education to establish "Graduate school of Environmental Toxins and Emerging Contaminants."

## Environment 2020

It is developing 22 detection techniques for hazardous air pollutants regulated by the Environmental Protection Administration (EPA).

**Environmental** 

Protection Administration (EPA) is to announce the control measures for hazardous air pollutants (HAPs).

## Academic Research and Journal Papers

After Super Micro Mass Research and Technology Center was transformed into a Center for Environmental Toxin and Emerging Contaminants Research

- 256 research papers of Science Citation Index (SCI) were published with 3,376 citations (excluding self-citation); 36 publications on hindex.
- Medal for Academic Environmental Protection Profession awarded by Environmental Protection Agency, Executive Yuan.
- Ta-You Wu Memorial Award by National Science Council.
- 2015 Highly Cited Research Paper Award, Applied Energy, Elsevier.
- Chiu-sen Award by Taiwan Association for Aerosol Research (TAAR).
- Distinguished Paper Award by Conference for Air Pollution Control Technology.
- Academic Paper Award by the Chinese Institute of Environmental Engineering.



## Patents obtained in the last 3 years

Patent No.	Patent Title	Date of Issue
M563251	Wireless portable system of an adjustable low-frequency shock wave for measuring bone cell hyperplasia	2018/07
M568966	Portable air quality inspection equipment	2018/10
M575357	Component separation and purification equipment	2019/03
M579561	Simulated moving bed for continuous separation and purification equipment	2019/06
M583854	Automatic Inoculation Equipment	2019/09
M590489	Capsule screening equipment	2020/02
M590478	The equipment for homogenization, purification and concentration of the extracts from Antrodia cinnamomea	2020/02
M590477	Equipment.for continuous purification and homogenization of Antrodia cinnamomea Triterpenoids	2020/02
M597287	Equipment for carbonization of Asphalt concrete planer waste	2020/06
M597286	Equipment for Graphene stripping	2020/06
M598734	Equipment for cooling and washing of recycled asphalt concrete	2020/07
M599243	The equipment for continuous feeding of recycled Asphalt concrete	2020/08

## International Certification and Recognition

The Environmental Toxic and Emerging Contaminant Research Center of Cheng Shiu University has a solid cumulated foundation for detection practical experience.



Every year, the center actively participates in international performance assessments for laboratories, including NIPH in Norway, BIPEA in France, RIKILT in Holland, EU-RL in German, and CIND in Italy. In the last years, this center joined InterCinD QA/QC for a comparison study. From 2000 to 2017, this center ranked among the top 25% of 120 large scale labs worldwide. Findings showed that both the accuracy and the precision of the analyses performed at the center, meet the international requirements:

# In 2016, the center ranked 1st and 2nd for accurate analysis of dioxins in various media.

#### In 2018 (87 laboratories worldwide)

- Accuracy (Z value±1, Outstanding) : 99.1% rated Good.
- Precision (r Value<0.2, Outstanding) : 97.4% rated Excellent.

#### In 2019 (54 laboratories worldwide)

- Accuracy (Z Value) : 100% rated Good , 89% rated Excellent.
- Precision (r Value) : 100% rated Excellent , ranked 13–18 globally.



# **CENTER Overall Operating**

The high tech and biomedicinal industries are currently flourishing, which causes a critical problem of the emission of various "Emerging Contaminant" and its impact on the environment. So far, the health risks and the comprehensive effects can not be assessed due to the immature detection techniques. Thus, amplification is required for potential polluters' detection and evaluation to formulate informed decisions.



Therefore, with support and assistance from all sectors, Cheng Shiu University is building a unique and iconic "Center for Environmental Toxin and Emerging-Contaminant Research (CENTER)". The center will continue to develop advanced analysis techniques from the multinational, interuniversities, and cross-discipline cooperation in response to the emerging issues in the fields of environmental pollution and global food safety.



## Professional Certifications awarded to the Laboratories

- To date, the center has obtained certifications of approval from the Environmental Protection Administration (EPA), Taiwan Accreditation Foundation (TAF), and Food and Drug Administration (TFDA) of the Ministry of Health and Welfare (MOHW). As of August 2020, it had 1094 certifications.
- EPA approved Institute for Environmental detection and measurement of contaminants (Certification No. 079), in several categories including air, Groundwater, Drinking water, industrial wastewater, soil, industrial waste, noise, toxic chemicals, and sea bottom, and the number of categories is constantly increasing.
- Certification from Taiwan Accreditation Foundation (TAF) (Certification No. 0664)
- Certification from Food and Drug Administration, MOHW (Certification No.025)
- MOHW approved Institute for urine tests for drugs (Certification No. A0014)
- MOHW approved Institute for Food Tests (Certification No. F070)

## Integrated analysis methods for tracing air pollution sources



 The center carries out systematic monitoring of pollutants using cloud technology. Further, modeling and simulation methods are applied to investigate air pollution events.



 The center applies information from forecasts on emissions and fingerprint investigations about stationary and mobile sources of dioxins to develop permanent continuous sampling systems.



 Develop reduction technology for permanent pollution sources, optimize the processes of start-up and stopping in the furnace control, Enzyme addition, and two medical waste incinerators system to significantly lower the emission of permanent pollutants.



## Diagnosing the efficiency of pollution control devices



- Establishing the efficiency of different air pollution control devices.
- Suggesting improvements and assisting in planning and design.
- Lowering the cost of monitoring the environment and society.









# Health risk assessment



- Carry out investigations on the concentration of dioxin and polychlorinated biphenyls in blood.
- Assess the concentration of heavy metals in urine samples.
- Health risks assessment for residents in specific areas of interest.
- Suggest emission reduction strategies for Carcinogenic pollutants.







## Investigations on soil and groundwater pollution

 Monitoring of soil and groundwater, component comparison of oil pollution source, chemical fingerprint comparison, and Molecular Biology Detection Technology.





 The center has trained 5 experts on soil investigation and evaluation. With their acquired skills, they can provide professional advice to industries and civilians on the land transactions.





## Environmental monitoring and impact assessment



• Environmental air quality.



- Environmental noise.
- Environmental vibration.
- Investigation of lowfrequency noise.



- Analysis of territorial water quality and sea bottom sampling
- Investigations on marine and land ecology.



## Reutilization of waste



Formulating a method for producing Graphene with planer waste

 Procedure for carbonization of Asphalt concrete waste





## Development of environmentally friendly materials

- Formulating the development of materials with low pollution for environmental protection.
- Assisting in designing production processes as well as planning the layouts of facilities in a factory.









# College and Research Cooperation Teams

## Overseas

- University of Pennsylvania, USA
- University of Maryland, USA
- Waseda University, Japan
- University of Tsukuba, Japan
- Universidad Politécnica de Valencia, Spain
- Nanyang Technological University, Singapore
- National Hanoi University, Vietnam
- The University of New South Wales, Australia
- Chulalongkorn University, Thailand
- Thammasat University, Thailand





## Local universities

- National Taiwan University
- National Cheng Kung University
- National Chung Hsing University
- National Chung Cheng University
- National Sun Yat-sen University
- National Health Research Institute,
- Academia Sinica
- Industrial Technology Research Institute

# Service Performance

From its establishment, this has provided professional services to more than 3000 units including:

#### **Government Units**

- 1. Environmental Protection Administration (Central competent authority)
- 2. County or City Bureau of Environmental Protection (Regional competent authority)

#### Public Enterprises

- 1. Taiwan Power Company (Capital: 11.2 Billion (USD)
- 2. CPC Corporation, Taiwan (Capital: 4.4 Billion (USD)
- 3. Taiwan Water Corporation (Capital: 4.7 Billion (USD)

#### Private Enterprises

<u>China Steel Corporation</u>:

China Steel Corporation is the largest steel company in Taiwan. The CENTER has assisted China Steel Corporation to establish its own flue discharge coefficient thus saving air pollution control and prevention costs up to 9 million Taiwan Dollars annually. Meanwhile, assisted this company to estimate air pollution with a model and draw up prevention and control strategies.

Taiwan Semiconductor Manufacturing Co., Ltd. 3

TSMC is the largest semiconductor IC foundry in the world. The CENTER assists in the control of air and water pollution as well as lowering the carbon emission in the efforts towards green manufacturing.

Advanced Semiconductor Engineering, Inc. :

ASE is the largest supplier of Outsourced Semiconductor Assembly And Test (OSAT) in the world. The CENTER is working with ASE on stocktaking and optimization of control techniques of scrubber/alkali exhaust and emission coefficient of particulate matter. The overall goal is to control pollution at the source.

Uni-President Enterprises Corporation

PECOS is the largest multinational food enterprise in Taiwan. The CENTER primarily assists PECOS in estimating the dioxin concentrations in various raw materials for food production as well as investigating soil and groundwater.

#### Formosa Plastic Group:

Formosa Plastic Group is one of the largest petrochemical enterprises in the world. The CENTER has been a long-term research partner for tasks such as pollution prevention, environmental monitoring, and soil, groundwater evaluation for each plant site. Moreover, the CENTER has worked on Formosa research group for some time on toxins and diseases for its medical business.

## **Promote New Southbound Markets**

The CENTER in Cheng Shiu University is now working on opening new southbound markets. Its planned activities include providing professional advice on techniques and experience, continuously promoting international visits and consultation, co-working on education and training, and participating in local or overseas exhibitions. Additionally, it plans to cooperate with multinational and environmental engineering companies in Taiwan, such as Ever-Clear Environmental Eng. Corp, which specializes in industrial wastewater treatment project, and Tai & Chyun Associates Industries, Inc., which specializes in Electrostatic Precipitator (ESP), etc. By matching up partners and multi-disciplinary cooperation the center can ensure the effective utilization of resources. Together, the stakeholders can share the fruits of cooperation by striving for international projects and providing services to local and oversea industries.



## Institute of

## **Environmental Toxin and**

## **Emerging-Contaminant**

In May 2020, Cheng Shiu University received official approval from the Ministry of Education to the establish the "Institute of Environmental Toxin and Emerging-Contaminant." This institute aims to cultivate the right talent and develop advanced technology for the CENTER to become a hub for international research.



## **About education:**

This institute provides curriculum and research practice for master's degree students to cultivate talents and decision-making skills about the environment. The aim is to improve their skill set concerning the investigation, simulation, and evaluation of pollution and environmental problems. Integrate available space and facilities in the CENTER to outline various courses that can be held in classrooms to provide practical skills in different contexts. Thereafter, the center plans to connect the programs at the institute with practice in the industry to promote advanced and top research on environmental toxic and emerging contaminants. The overall goal is to educate future leaders that can directly connect with the sustainable development.

## **About research:**

Research areas include topics on air pollution, water pollution, waste pollution, soil and groundwater pollution, green energy, environmental toxins, emerging contaminants, environmental assessment, decision-making systems with their scientific fundamentals and application techniques, and technology development.



## About service:

Accepts requests from governments, research institutes, public or private sectors of industry to conduct industry-academic cooperations in research, management, investigation, and evaluation.



# Programs in the institute are set to be open for application in March, while the classes will start in August 2021.

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