SAO PAULO STATE GOVERNMENT

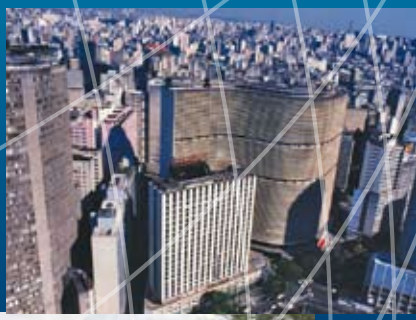
ENVIRONMENT SECRETARIAT

CETESB • ENVIRONMENTAL AGENCY OF SÃO PAULO STATE

• REGIONAL CENTRE OF STOCKOLM CONVENTION FOR LATIN AMERICA AND THE CARIBBEAN REGION

Environmental Management on POPs












CETESB's MISSION

CETESB - the Environmental Protection Agency of Sao Paulo State - was created in 1968. It is part of the State Environmental Secretariat and its activities are funded by the state government. Sao Paulo has a population of 40 million inhabitants and an area of 248,000 sq. km and it is a very important state economically in Brazil. It concentrates a large number of agricultural and industrial activities that use a variety of chemical products.

CETESB's mission is to improve and to assure environmental quality of Sao Paulo State in order to achieve social and economic sustainable development. To accomplish this task CETESB has 46 offices distributed in the state with around 2000 employees, most of them graduated, including engineers, biologists, chemists, etc.

As a result of its expertise acquired in the last forty years of activity in a variety of technical fields, CETESB is considered a reference centre for a number of environmental actions. CETESB remains one of the 16 Reference Centres for the United Nations - UN on environmental issues, one of the five reference institutions on issues like water supply and sanitation for the World Health Organization - WHO. It is also considered as the reference and advisory centre of the United Nations Program for Development - UNDP on issues related to hazardous waste in Latin America and the Caribbean, one of the three Collaborating Centres of Pan American Health Organization / World Health Organization - PAHO / WHO, prepared to deal with emergencies in case of disasters. Furthermore, it is responsible for feeding

MAIN ACTIVITIES

• ENVIRONMENTAL PERMITTING AND CONTROL OF POLLUTION SOURCES

CETESB`s permitting activities in the State of Sao Paulo are based on the assessment of the environmental social and economical impacts of pollution. The Company issues permits, controls, enforces regulation and applies fines on existing sources of pollution.

CETESB has registered more than 220,000 potentially polluting activities in Sao Paulo State and issued 35,945 permits last year, including pre-operation, installation, and renewals. Among these sources CETESB has permitted, controlled and enforced different sources of pollution categories, listed in Parts II and III in Annex C of Stockholm Convention, and developed several technical criteria which take into consideration processes, techniques or practices that avoid the formation and release of chemicals listed in Part I of Annex C

• CLEANER PRODUCTION

CETESB has expertise in cleaner production on specific industrial sectors and develops pilot project on this subject. CETESB has prepared 14 guidelines in partnership with several Industry Associations. CETESB and UNEP have reached an agreement for the establishment of a SPC network which is going to be developed under the UN's Marrakech Process, aiming to promote sustainable patterns of consumption and production in this region.

For further information, please visit the site: http://www.cetesb.sp.gov.br/Tecnologia/prevencao_poluicao/conceitos.asp

information and reviewing training courses for Training Network on Sustainable Production and Consumption for Latin America and the Caribbean Region -SPC under UN's Marrakech Process and it is part of the National Communication of Greenhouse Gas- IPCC. It also coordinates the network on soil and groundwater contamination prevention, remediation, hazardous waste clean-up, and brown fields redevelopment for Latin America and the Caribbean, and disseminates concepts for the Clean Development Mechanism - CDM of the Kyoto Protocol and supports the actions of the PROCLIMA and coordinates the REPIDISCA - Pan American Network of Information in Environment.

CETESB has also agreements with the World Bank, United Nations Development Programme - UNDP, United Nations Environment Programme - UNEP, Pan American Health Organization- PAHO, U.S. Environmental Protection Agency - EPA, Inter-American Development Bank - BID, International Bank for Reconstruction and Development - BIRD, Agency of Commerce of the United States – TDA, The German Federal Environment Agency – UBA, Environment Canada, Japan International Cooperation Agency - JICA, the Ministry of Science and Technology of the British Government and Ministry of Environment of Brazil.

In May of 2009, CETESB was ratified as one of eight Regional Centres to the Stockholm Convention (SC) on Persistent Organic Pollutants - POPs for Latin America and the Caribbean Region.




• ENVIRONMENTAL LABORATORIES

Set up with modern facilities, equipped with analytical instruments based on leading-edge technology, the laboratories at CETESB perform more than 250,000 analyses per year, encompassing a wide variety of physical, chemical, biological and toxicological tests on the most different matrices. The labs operate in an integrated way for controlling the pollution and monitoring the environmental quality, aiming to protect human and environmental health.

Table 1 – Laboratory Tests

Physico chemical	Aggregate organics:- BOD, COD, TOC, oil & grease, phenols, surfactants
	Inorganic compounds: - metals, nutrients, volatile and fixed solids, sulfates, sulfides, fluorides, cyanides, etc.
	Organic compounds: organ chlorinated and organophosphorated pesticides, chlorinated phenoxiacid herbicides, PCBs, halogenated phenols, PAHs, volatile organic compounds
Ecotoxicological	Acute and chronic toxicity tests (Bacteria, algae, microcrustaceans and fishes)
	Mutagenicity/Genotoxicity tests (Salmonella assay, micronuclei, single cell gel assay)
	Studies on bioaccumulation in aquatic organisms
Microbiological and Parasitological	Contamination indicators (coliforms, E.coli, Enterococci, Pseudomonas aeruginosa, Clostridium perfringens, S. aureus, C. albicans, bacteriphages, heterotrophic bacteria and others)
	Pathogens (Salmonella sp, Vibrio cholerae, enteric viruses, protozoa, helminthes etc.) and microcysti
	Microorganisms associated with corrosion and water deterioration
Hydrobiological	Aquatic communities (benthic macroinvertebrates, phyto and zooplankton, fishes) and transition communities (coastal rocks)
	Mangroves – structure and function
	Toxic algae
	Chlorophyll
Emission (light duty vehicles)	Carbon monoxide, hydrocarbons, aldehydes and nitrogen oxides







Matrices

- Water: drinking water, surface water (fresh and sea water), groundwater, bathing water, wastewater.
- Sediments and Soil
- Solid waste (hazardous waste, sludge, industrial waste, landfill)
- Aquatic organisms (fish, bivalves)
- Air (particulate material, vehicle emission, chimney emission, indoorr)

Sampling

CETESB counts with specialized teams very well equipped and experienced for sampling:

- surface water, sediment, and aquatic communities (fish and bivalves, phytoplankton, zooplankton, benthic organisms);
- industrial effluents;
- solid waste, soil, contaminated sites;
- groundwater;
- air (particulate material and emissions).

Analytical Methods

The analytical methodologies applied at the laboratories are in compliance with the methods established by ABNT (Brazilian Association for Technical Standardization) and international institutions, such as Standard Methods for Water and Wastewater (USA), US Environmental Protection Agency, ISO (International Standardization Organization EU) and DIN (German Institute for Standardization-EU), Environment Canada.

Quality Assurance / Quality Control

CETESB labs carry out the analysis within the strictest QA/QC patterns. The laboratories are ISO/IEC 17025:2005 accredited a quality management system that recognizes the technical competence of these labs. The accreditation scopes cover today around 300 environmental tests: inorganic and organic, microbiological, parasitological, ecotoxicological, mutagenicity, and vehicular emission testing and sampling procedures.

Environment Chemistry: Persistent Organic Pollutant (Pop) Testing

Division of Chemistry Analysis was established in 1975 for analysis in drinking and surface water. The first organic analyses implemented at organic laboratory were organ chlorine pesticides, organophosphorous pesticides and fenoxy acids herbicides. In the beginning of 1980s CETESB started to analyse polychlorinated biphenyls (PCBs) in dielectric fluids (transformers) and water. Nowadays the laboratory performs a great diversity of organic tests in different matrices.

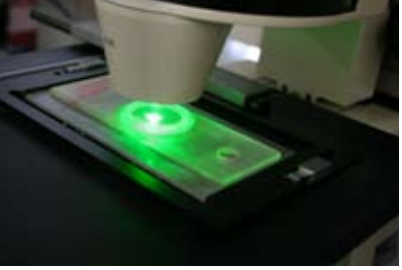
Stockholm Convention focus – POPs

CETESB laboratories provide facilities, equipment and personnel needed for investigations of POPs conducted to support:

- Environmental enforcement efforts such as industrial effluents, industrial solid waste, contaminated soil, air emissions, air quality and ground water.
- Surface water, soil, ground water and air monitoring programs.

POPs Testing

- Organ chlorine pesticides (OCPs):
  Lindane
  α Endossulfan, β Endossulfan, Endossulfan sulphate
  α Chlordane , γ chlordane
  4,4'DDE, 4,4'DDT, 4,4'DDD
  Aldrin
  Dieldrin
  Endrin keton, endrin aldehyde
  Heptachlor, epoxy heptachlor, metoxichlor
  Hexachlorobenzene,
  Mirex
  Toxaphene



- Polychlorinated biphenyls (PCBs):
  Arochlor - 1016, 1221, 1232, 1242, 1244, 1248, 1254, 1260;.
  Congeners: 2,4,4´trichlorobiphenyl (PC B28), 2,2',5,5' tetrachlorobiphenyl (PCB 52), 2,2',4,5,5' pentachlorobiphenyl (PCB 101), 2,3',4,4',5 pentachlorobiphenyl (PCB 118), 2,2',3,4,4',5' hexachlorobiphenyl (PCB 138), 2,2',4,4',5,5'hexachlorobiphenyl (PCB 153), 2,2',3,4,4',5,5'heptachlorobiphenyl (PCB 180)
- Polychlorinated dibenzo-p- dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs): CETESB has just installed a new laboratory for dioxins and furans analysis and the expectative is to have the lab in performance to meet the internal and clients demand for air analysis by August 2009.

QA/QC and Laboratory Accreditation

The laboratory has a strong quality control program, including besides the routine tests of QC participation in proficiency assays and analyses of certificate reference material. The scope of ISO/IEC 17025:2005 accreditation for organic tests covers polycyclic aromatic hydrocarbons (PAHs), organ chlorine pesticides, polychlorinated biphenyls, volatile organic compounds (VOCs) for environmental matrices.

In regard to environmental laboratories, CETESB as a Nominated Centre, aims to share its knowledge in order to strengthen the capacity of analyses on POPS of Latin America and the Caribbean.

Table 2. Methods for OGPs and PCBs Identification and Quantification

Compound	Matrices	US EPA Method		
		Extraction	Clean Up	Analysis
Organochlorine pesticides	Liquid[1]	3510	3620/3630	508 and 8081B
	Solid[2]	3540/3546	3620/3630/3660	8081B
	Biological[3]	3540C/3540	3620/3630	8081B
Polychorinated byphenyls	Liquid[1]	3510	3620/3630/3665	8082A
	Solid[2]	3540C/3546	3620/3630/3665	8082A
	Biological[3]	1668 (preparation)/ EPA3540	3665	8082A

[1.] Drinking water, freshwater, ground water, effluent; [2.] Soil, sediment and hazardous waste; [3.] Fish and shellfish

Equipments:

- Gas chromatography /ECD detector with package column for screening.
- Gas chromatography / ECD detector with capillary column.
- Gas chromatography / low-resolution mass spectrometry with capillary column
- Gas chromatography / mass spectrometry (CG/MS/MS)
- High-resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS)

• ENVIRONMENTAL QUALITY MONITORING

CETESB carries out a variety of environmental monitoring programs including air, water and soil quality. Some of them provide real time data as shown on the Table 3.

Table 3. Field Testing and Real Time Monitoring. (CETESB,2008).

Field Analysis	pH, temperature, conductivity, dissolved oxygen
Real time water monitoring	Telemetric stations: dissolved oxygen, pH, temperature, turbidity, electric conductivity, BOD, ammoniacal nitrogen and soluble phosphate
Real time air monitoring	Telemetric stations: carbon monoxide, hydrocarbons, nitrogen oxides, sulphur oxides, inhalable particles

Water Quality and Sediment Monitoring

According to Brazilian legislation, water resources have three main uses: public supply, aquatic life protection and recreational activities. Specific variables for water quality and sediments and water quality indexes are used for each of these three categories. The main sources of water pollution in São Paulo State are the domestic and industrial effluents, in addition to the diffuse load, originated from urban or agricultural areas.

CETESB carries out five water quality monitoring programs to assess the quality of the aquatic environments for different purposes providing and permanent diagnosis of the water resources. These programs generate a data set of more than eighty thousand records per year (Table 4).

There are four freshwater monitoring programs with a total of 411 sampling sites in the State. To evaluate the presence of contaminants in the water, CETESB uses 50 (fifty) different water quality variables. As water results are subject to great variation, sediment quality has been also used to evaluate aquatic environment because it is a more stable compartment and can provide an historical register of environmental condition. Currently, there are 26 sampling sites for sediment quality assessment, where there are analyzed up to 34 physical-chemical, ecotoxicological and hydrobiological. For further information visit the site http://www.cetesb.sp.gov.br/Institucional/info_amb.asp

In the coastal waters the beach water quality program evaluates 155 sites of 136 beaches in 427 kilometers of coastline, covering 15 counties.

Table 4. Water Quality and Sediment Monitoring (CETESB,2008)

Monitoring Programme	Objectives	Year of Operation start	Sampling points General	Sampling points with SC POPs
Basic Freshwater	To provide an overall diagnosis of water resources	1974	333	7 (*1)
Sediment	To complete the diagnosis of monitoring of rivers and lakes	2002	26	18
Beaches Sea Water	To inform the freshwater bathing conditon for recreation use.	1968	155	-
Beaches Freshwater		1994	36	-
Automatic		1998	13	-

(*1) specific Project of Pinheiros River/ Billings Reservior

IQS- Sediment Quality Indexes

The chemical sediment quality index, related to the aquatic life protection, is based on the values established by "Canadian Council of Ministers of the Environment " (CCME, 2002) for arsenium, heavy metals and organic compounds, using three classes of chemical contamination

The same guideline values were adopted by CONAMA Resolution 344/04, (Brazil, 2004), a federal legislation which establishes the basic directives and procedures for dredged material evaluation. The data generated in the last five years, has allowed the refinement of the chemical diagnosis in 5 (five) quality classes, based on the TEL and PEL values. The toxic contaminants in the natural water sediments are currently classified based on the TEL and PEL criteria, according to Figure 1.

PEL (Probable Effect Level): level above which an adverse effect for bentonics organisms is often expected. TEL (Threshold Effect Level): level under which the harmful effects to bentonics organisms are can hardly ever be found. The same procedure is adopted by CETESB, to evaluate the chemical substances in the sediments.

Figure 1 – Chemicals Contaminants classification in five ranges of quality related to TEL and PEL criteria. (CETESB,2008)

Stockholm Convention focus – POPs

CETESB evaluates Stockholm Convention POPs, except Dioxins and Furans, in sediments of 18 sites according to Figure below.

In the marine environment persistent organic compounds were evaluated in 2007 in the sediments around Santos sewage outfall, in two campaigns and in three different sampling points (Figure 3). The purpose of this survey was to evaluate the influence of sewage disposal on sediment quality and its organic compound concentration. The compounds analyzed were: total PCBs and similar and chlorinated biocides. For further information visit the site http://www.cetesb.sp.gov.br/Institucional/info_amb.asp

Figure 2- Map of Evaluation of POPs in Sediment Quality Network (CETESB,2008)

Figure 3 - POPs Monitoring in Sediment of Sea Water (CETESB,2007)




Air Emission and Quality Monitoring

The Air Emission and Quality Department is involved in different tasks such as evaluating industrial processes and projects of air pollution control, execution and/or analysis of air emission samplings in industrial sources, calibration of components of sampling systems and evaluation of air pollution impacts from industrial sources in Sao Paulo State.

Furthermore an important tool to support the corrective and preventive actions to control air pollution and prevent environmental degradation is the air quality monitoring. This task is performed through the operation and maintenance of a network of automatic monitoring stations. Currently CETESB has 39 fixed and 3 mobile stations distributed in Sao Paulo Metropolitan Area (22), in the coast (3) and in country area of the State (15), according to maps in Figure 4. The daily reports of air quality are published on CETESB website and by the spoken and written press. CETESB also maintains a manual air quality monitoring network in 26 cities of Sao Paulo State and increases the use of bio indicators, specifically for fluoride and ozone, as a tool to support assessment of air quality, according to Figure 5. The monitoring parameters are shown on the Table 5. For further information visit the website http://www.cetesb.sp.gov.br/Institucional/info_amb.asp

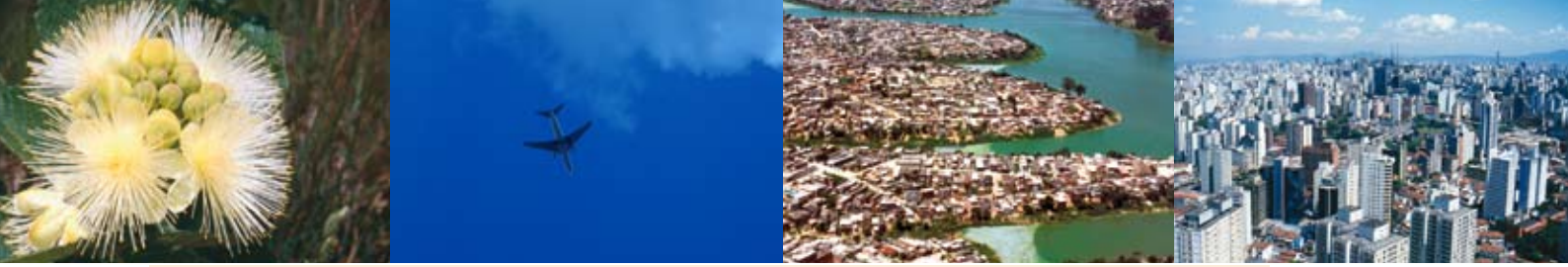
Table 5. Air parameters of quality monitoring. (CETESB,2008)

Automatic Network

- SO2 Sulfur Dioxide
- NO Nitrogen Monoxid
- NO2 Nitrogen Dioxide
- NOX Oxide
- O3 Ozone
- CO Carbon Monoxid
- UR Air Humidity
- TEMP Temperature
- VV Wind Speed
- DV Wind Direction
- Particulate
- MP10 Inhalate particulate

Manual Network

- SO2 Sulfur Dioxide
- FMC Smog
- PTS Suspension Total Particulates
- MP2 5 Thin Inhalate particulate
- MP10 Inhalate particulate



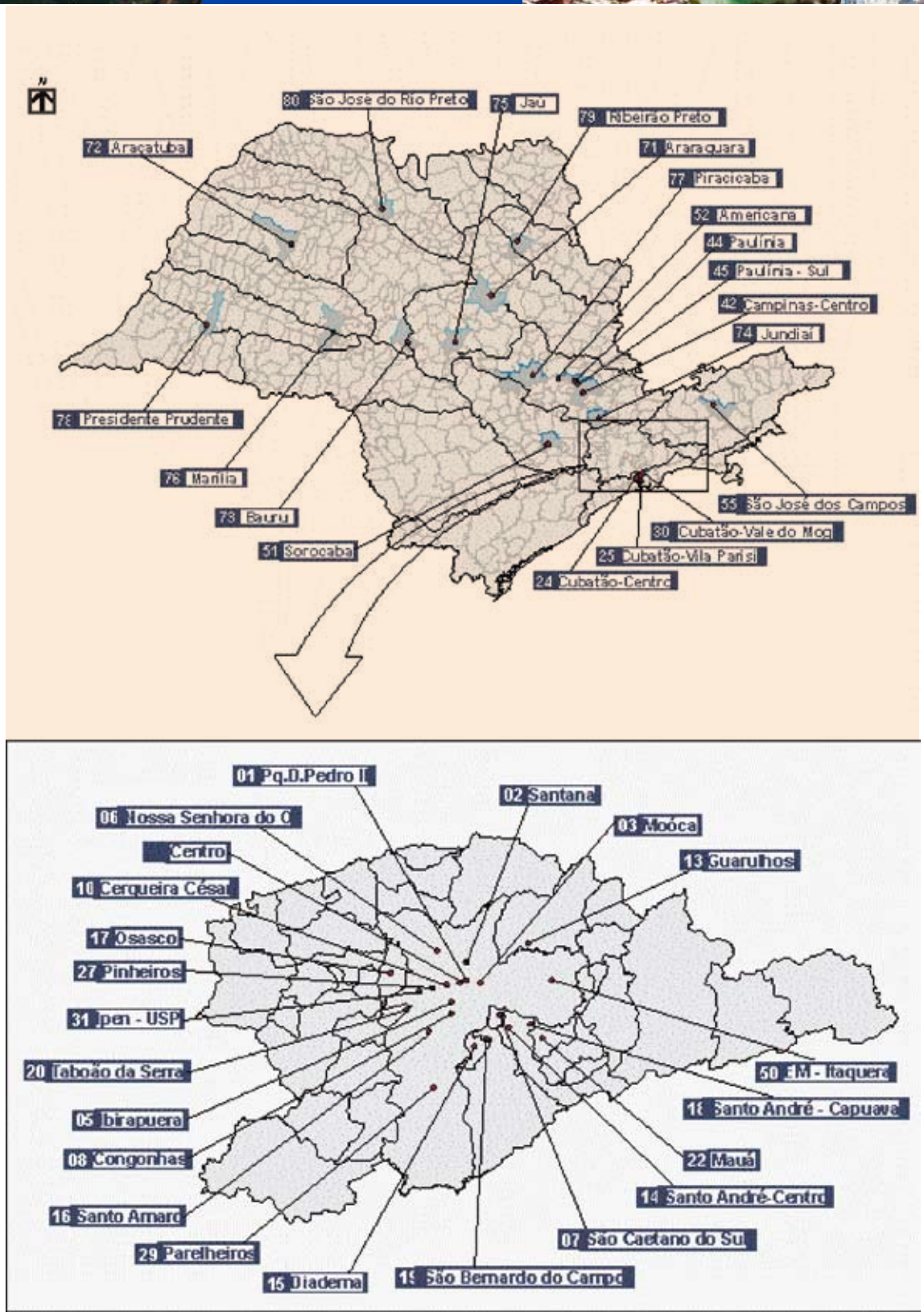
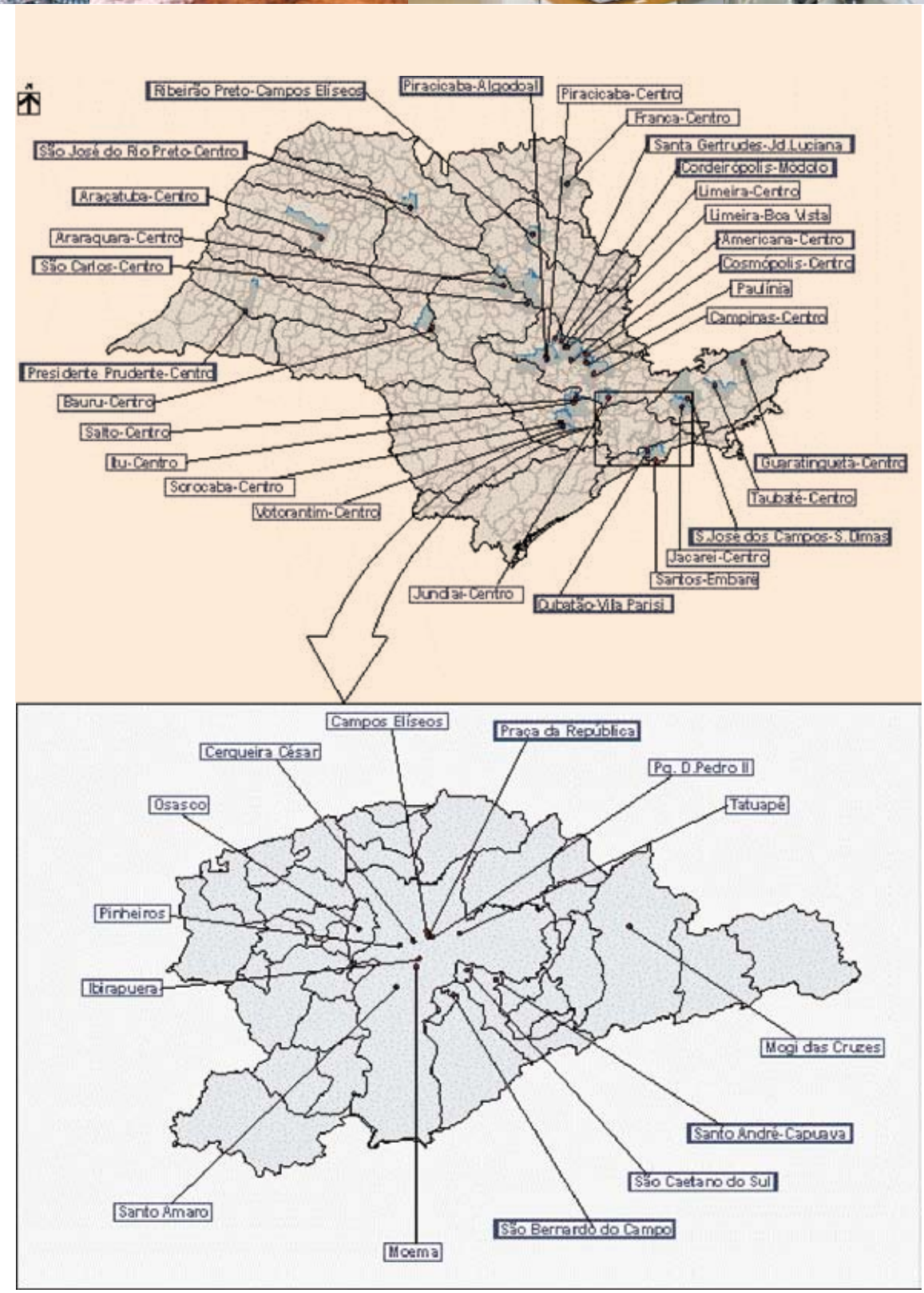


Figure 4 - Map of Stations of Automatic Air Quality Monitoring Network. (CETESB,2008)

Figure 5 - Manual Stations of The Air Quality Monitoring Network. (CETESB, 2008)



Stockholm Convention Focus – POPs Monitoring Dioxins And Furans In Stack Emis-




sions

The beginning of the dioxins and furans emission monitoring in stationary sources in São Paulo State coincided with the implementation of hazardous waste incinerators in 90´s decade. CETESB led this work by studying the background of the method for sampling and analysis of dioxins and furans U.S. in the stack (EPA Method 23 - dioxin and furan). At that time, every owner of a hazardous waste incinerator had the obligation to make the necessary assessments to execute a trial burn test. All tests were supervised by the CETESB's technical team to ensure the fulfillment of all requirements for collection, preservation and quality of the sample.

Nowadays, the assessment of dioxins and furans emissions has been a common practice in various activities such as incineration of hazardous waste and health services, coprocessor residue in furnaces and boilers, cremation and any thermal treatment of waste which has potential emission dioxins and furans. CETESB has a team specialized in sampling from stationary sources which is able to collect samples and audit tests carried out by third parties.

Soil and Groundwater Monitoring

Since 1990, CETESB has monitored the quality of groundwater by collecting 170 points, most of them being public supply wells, located in the main aquifers of the state. It has evaluated more than 40 physical, chemical and microbiological parameters, distributed in 19 Watershed Management Hydric Resources Unit's - UGRHIs. POPs substances are not determined considering they are not expected to be found in groundwater. This monitoring allows the publication of a technical report every three years. For further information visit the site: http://www.cetesb.sp.gov.br/Solo/agua_sub/rede_historico.asp

CETESB has also focused on soil condition evaluation on a regional scale. In 2001, CETESB developed soil and groundwater guideline values to subsidize the protection of soils and groundwater quality and the management of contaminated sites. Soil guideline Values for Quality Reference - VRQ, Prevention - VP and Intervention - VI were established. The Prevention values aim to protect both soil functionality and ecological receptors whereas the Intervention values aim to protect human health. The Soil and Groundwater Values area reviewed each 4 years and the last version with 84 (eighty - four) substances was published in 2005. For further information visit the site: http://www.cetesb.sp.gov.br/Solo/relatorios.asp

Stockholm Convention focus – POPs

Related to SC POPs, there are established prevention and intervention guideline values for six SC POPs: Aldrin, Dieldrin, Endrin, DDT, DDE, DDD, Hexachlorobenzene and total PCBs.

In 2008, CETESB published the first report on the soil quality condition of the Alto Tiête´s Watershed – UGRHI 6, which also includes the Metropolitan Region of the São Paulo City - RMSP. In this evaluation, superficial soil samples from agricultural and forest fragment areas were collected and analyzed for the following POPs: Aldrin, Dieldrin, Endrin, DDT, DDE, DDD, Hexachlorobenzene, Heptachlor, Epoxide heptachlor, Mirex and Toxaphene.

POPs were detected in 31 soil samples (23 samples agricultural areas and 8 forest fragment areas) out of a total of 108 samples collected in this region. DDTs and their isomers were detect-

ed in 22 samples according to Figure 6 bellow. In 14 soil samples, most of them from agricultural areas, POPs concentrations exceeded the guideline values, according to Table 6. Where the concentrations results are upper the Intervention Value - VI, the detailed investigation and human health risk evaluations can be carried out for local rehabilitations.

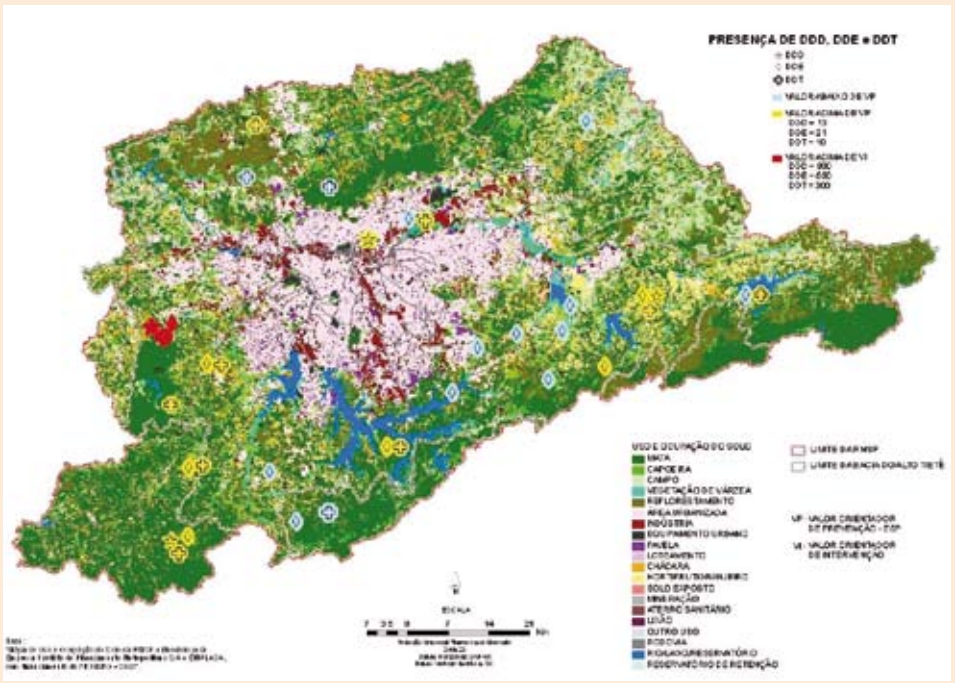


Figure 6 – DDTs and their isomers in 22 samples in Alto Tiête´s Watershed Region – UGRHI 6 (CETESB, 2008

Table 6. Minimum and maximum concentrations of POPs in soil samples collected at the Alto Tietê watershed and comparison to the São Paulo State Guideline Values. (CETESB, 2005).

SUBSTANCE	Land Use	Minimum Maximum	VP	VI agricultural	>LQ and <VP	>VP and <VI	> VI agricultural	Total
		µg.Kg-1	Number of Samples					
Aldrin	AG	<1.25 – 9.91	1.5	3.0	-	1	1	5
	MA	<1.25 – 10.60			-	2	1	
Dieldrin	AG	<1.25 - 114	43	200	5	1	-	6
	MA	<1.25			-	-	-	
DDD	AG	<2.50 - 913	13	800	-	3	1	4
	MA	<2.50			-	-	-	
DDE	AG	<2.50 - 1020	21	300	11	4	1	18
	MA	<2.50 – 16.20			2	-	-	
DDT	AG	<2.50 - 560	10	550	1	7	1	13
	MA	<2.50 – 12.70			2	1	-	
Hexachlorobenzene	AG	<0.50 – 3.08	3,0	5	2	-	-	4
	MA	<0.50 – 1.76			1	-	1	

AG – Agricultural area (n= 48); MA – Forest fragment (n= 60); LQ – Limit of quantification; VP – Prevention values; VI Agricultural – agricultural Intervention values. All the results were below the limit of quantification (LQ) for the following substances: Endrin (<3.75 µg Kg-1), Heptachlor (<1.25µg Kg-1), Mirex (<2.50µg Kg-1) and Toxaphene (<50.0µg Kg-1).

• Contaminated Sites Management

Contaminated sites in Sao Paulo State started to be identified in the 1980s. Most of them were related to inadequate environmental practices, resulting in the contamination of soil and groundwater. CETESB's expertise acquired by dealing with these cases and the interchange program with institutions and professionals from Germany, Netherlands and USA, lead to the establishment of a procedure for the management of contaminated areas. CETESB maintains a multidisciplinary investigation team, who conducts environmental drilling (Direct Push and Hollow Steam Auger), soil sampling, monitoring well installation, ground-water sampling, and non-invasive site investigation with geophysical equipment (GPR, EM-31, EM-34 and EM-61).

The management of contaminated sites in the State of Sao Paulo is conducted by following the guidelines that are listed below.

- Handbook of Contaminated Sites Management, published in 1999. It is a technical guideline on for identification, investigation and remediation of contaminated sites.
- Guideline Values for Soils and Groundwater, established in 2001 and updated in 2005. It shows the reference concentrations in soil and groundwater for chemicals compounds that are used to determine the quality or the existence of contamination of these compartments.
- Rules for Management of Contaminated Sites - published in 2007. It contains the procedures for the management of contaminated sites in the State, including measures for the identification, characterization and rehabilitation of these sites and the definition of responsibilities.
- Corrective Action Based on Risk (ACBR) Applied to Areas Contaminated with Hydrocarbons Derived from Oil and Other Liquids Fuels - Procedures – first published in 2000 and revised in 2006. This document presents a method of decision making which is based on human health risk for fuel contaminated sites.

Guideline for Assessment of Potential Contamination in Properties, published in 2003. It is a guideline that was developed to help the ones involved in properties transactions to evaluate the real estate of one property in terms of contamination and also the precautions that should be taken before the purchasing in order to avoid further problems related to contaminated sites.

Besides these tools, there is a proposal of a piece of law that has been subjected to approval by the State Legislative Assembly. This piece of law establishes the rules for protecting the soil quality and the management of contaminated sites. It also sets the bases for the calculation of human health risk assessment and the goals for remediation of contaminated sites.

Nowadays, 2,514 contaminated sites have been identified in the State of Sao Paulo, among them 78% are caused by leaking of underground tanks in gas stations. Nevertheless, the most critical cases are associated with industrial activity, within the production process or the final destination of their waste. Among those sites, 38 were contaminated by POPs, as presented in the Table 7.

Table 7. Number of sites contaminated with POPs. (CETESB, 2009).

POP	Number of sites
Aldrin	5
Endrin	2
Dieldrin	4
Toxafeno	1
Hexaclorobenzeno	12
PCB	17
DDT	1
Dioxinas e furanos	1

Detailed investigations and human risk assessment have being conducted in all those sites in order to determine the needs for intervention. At the moment 21 sites have been remediated, 1 site had been remediated and rehabilitated for future use and 16 sites are still under investigation.

Contaminated sites can be found all over the state of Sao Paulo, they are however, concentrated in Sao Paulo's Metropolitan Region, where most of the industries and gas stations are located. This geographical distribution can be seen in the Figure 7.

Information on these sites is published by CETESB in its web portal and can be accessed in http://www.cetesb.sp.gov.br/Solo/areas_contaminadas/relacao_areas.asp

As a Regional Centre, in regard to contaminated areas, CETESB can share its knowledge with Latin America and the Caribbean countries that are starting the program of contaminated sites management, or exchange experiences with countries that are already running their program.

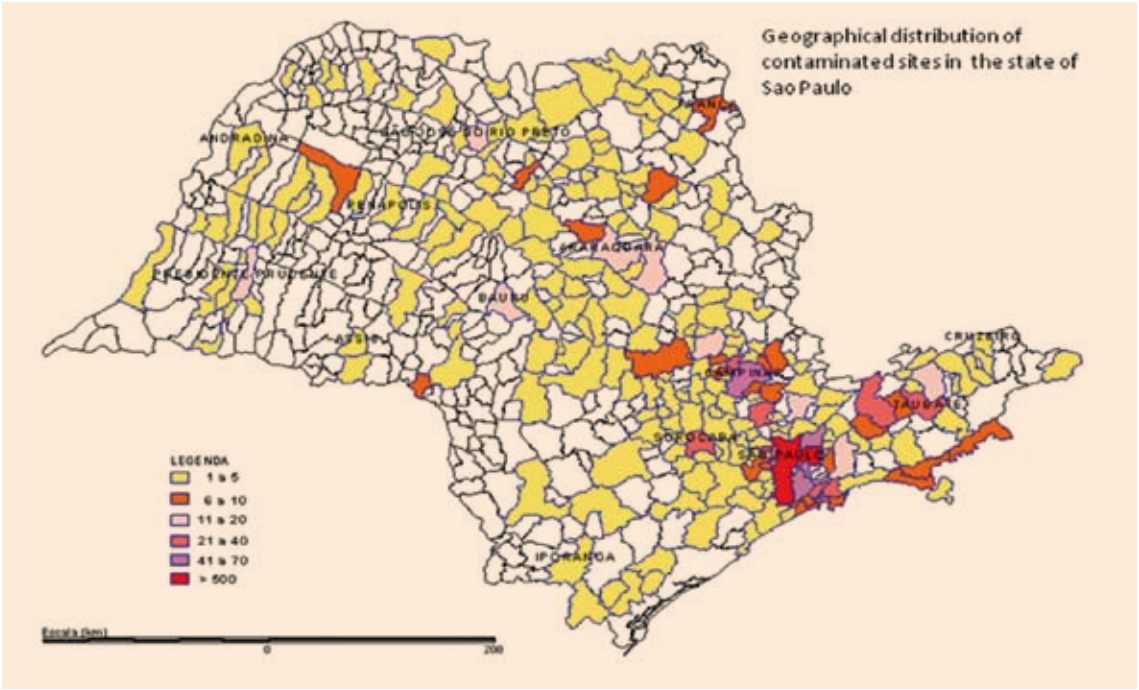


Figure 7. Geographical Distribution of Contaminated Sites in São Paulo State. (CETESB,2008)

• Solid Waste Management

CETESB's regulations are focused on solid waste minimization as well as pollution control and as a result of this approach, business and medical establishments, industries, municipalities have changed their strategies. In this way, these actions contribute to avoid waste generation, reducing the amount of consumed materials and their toxicity, maximizing the use of materials, and establishing procedures to sort and recycle waste materials and defining disposal technologies that may lead to energy and material recovery, with the safe destruction of pollutants and toxic substances.

The solid waste is classified according to Brazilian Guidelines, as Hazardous (Class I) and non Hazardous (Class II A and IIB). However, there are other regulations that classify the solid waste by origin for management purposes. These regulations are presented in the Appendix.

Municipal Solid Waste

Sao Paulo State produces about 27,000 tons of municipal solid waste a day and there are some programs for sorting out its reusable material. CETESB has promoted an integrated management of municipal solid waste, based on source reduction and minimization techniques and technologies and it counts with the participation of stakeholders such as nongovernmental organizations, recycling businesses and industrial associations.

Since 1997, CETESB has intensified the actions to reduce waste impacts, looking for a sound urban waste management. The quality of urban solid waste disposal areas is measured by an index called IQR - solid waste disposal areas quality indicator, which is presented in the Sao Paulo State Inventory of Urban Solid Waste. For further information visit the site http://www.cetesb.sp.gov.br/Solo/residuos/urbanos_saude.asp

At this moment, CETESB has an agreement with the Bavarian Government and they have a project in order to install an Energy Recovery Unit - URE for treatment of urban , medical , non hazardous industrial solid waste .Criteria for operations conditions, control and monitoring have been established in order to meet the Best Available Technology.

Besides, CETESB develops studies related to greenhouse gas management generated by waste in Brazil, as a part of the National Communication of Greenhouse Gas, which it is in compliance to UNFCCC commitments. CETESB hosted a meeting of IPCC and cooperates to issue the Greenhouse gas Guidelines and hosts a webpage to support a network related to biogas use. CETESB also represents the Federal Government at Methane to Markets Partnerships as CIFAL- Atlanta, PNUD, Word Bank, US-EPA and ICLEI, and promotes technical assistance in order to identify opportunities of biogas used in several counties.

Stockholm Convention focus – POPs: elimination of open burning of waste

CETESB carries out actions such as enforcement and application of fines in order to eliminate the open burning of waste. As shown in Figure 8 and Figure 9, intense control measures have contributed to decrease the number of waste open burning sites in Sao Paulo State.

Medical Solid Waste

According to the State legislation, CETESB is responsible for the licensing of medical waste treatment and final disposal facilities, which includes environmental assessment and evaluation of technological feasibility as well. CETESB also establishes guidelines regarding to medical solid waste monitoring procedures as well as its management. The main medical waste treatments facilities installed in Sao Paulo State are incinerators, microwave and autoclave.

Industrial Solid Waste

Industrial solid waste was inventoried two times, at the end of the 1980th and at beginning of the 1990th. The inventories covered approximately 1 800 industries in Sao Paulo State, out of which 500 in Sao Paulo Metropolitan Region. Figure 10 shows the amount of solid waste that was generated per class of solid waste. The amount of industrial hazardous solid waste generated in the state of Sao Paulo per industrial sector is shown on Figure 11.

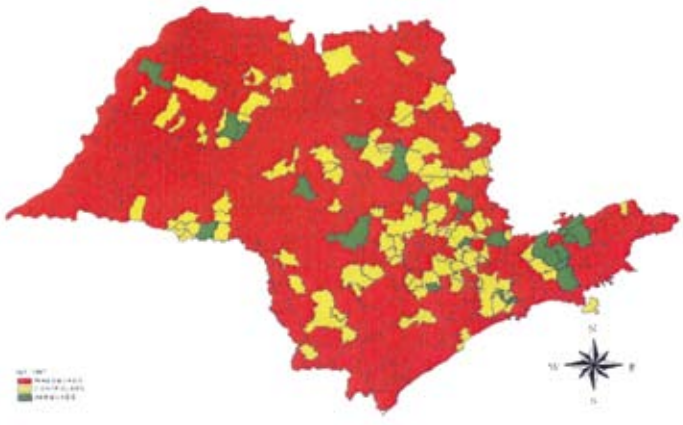


Figure 8. Urban solid sources before controlling. (CETESB, 1998).

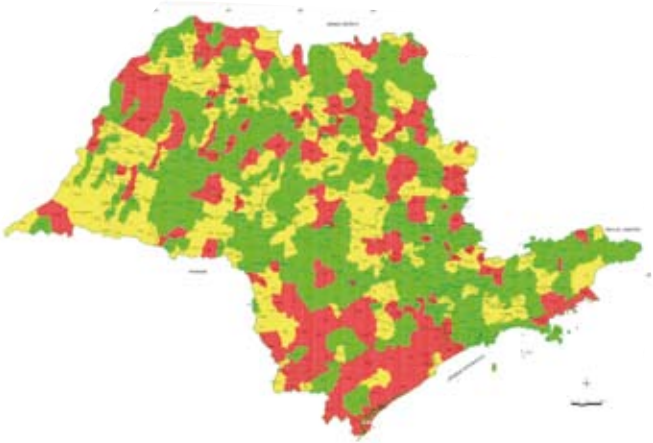


Figure 9. Urban solid waste disposal quality indicator after sources controlling. (CETESB, 2008)

UNADEQUATE (IQR < 6,0) CONTROLLED (6,1<IQR< 8,0) ADEQUATE (IQR >8,1)

Destination and Final Disposal

Brazil has 30 cement kilns plants that have permit to co-process industrial solid waste, out of which three of them are located in Sao Paulo State, as shown in Figure 12. There are 2 units in Sao Paulo that are blending wastes for Cement Kiln Processing, as shown in Figure 13 .

The permits of the cement kiln and incineration plants are based upon federal and CETESB's regulations and depends on trial burn results. These regulations define, for instance, the emission limits for PCDD/F (limit: 0.1 ng/Nm3 TEQ). There are limitations for types of waste that could be burned and also limitation for their calorific values in order to allow them to be co-processed in cement kilns. The waste has to be either a raw material or a fuel substitute. Some wastes, for example pesticides, medical wastes, are not accepted to be fed in the kilns.

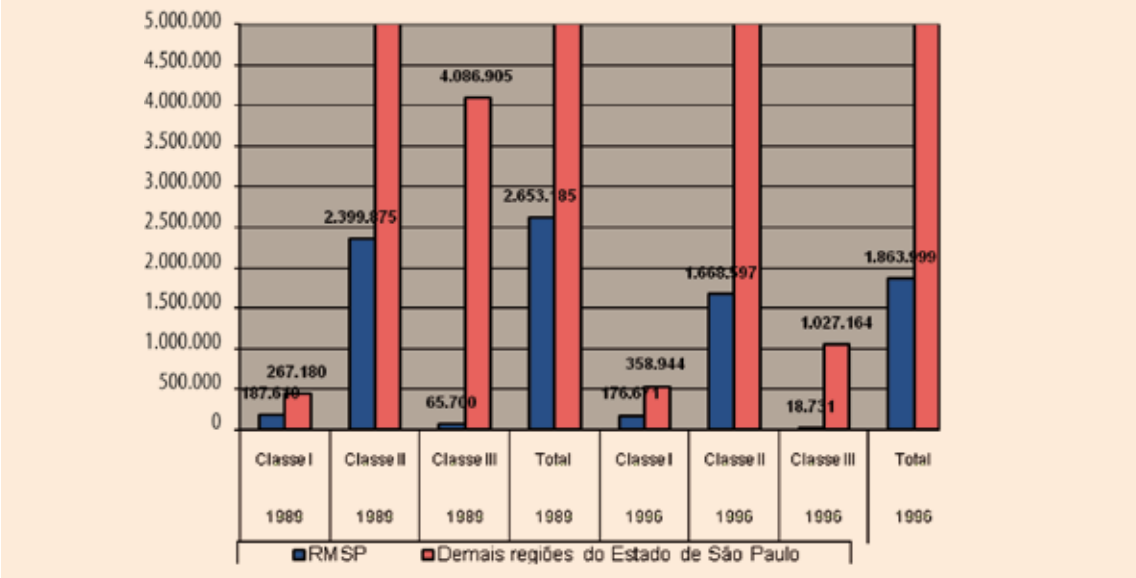


Figure 10. Generation of industrial waste (CETESB, 1997)

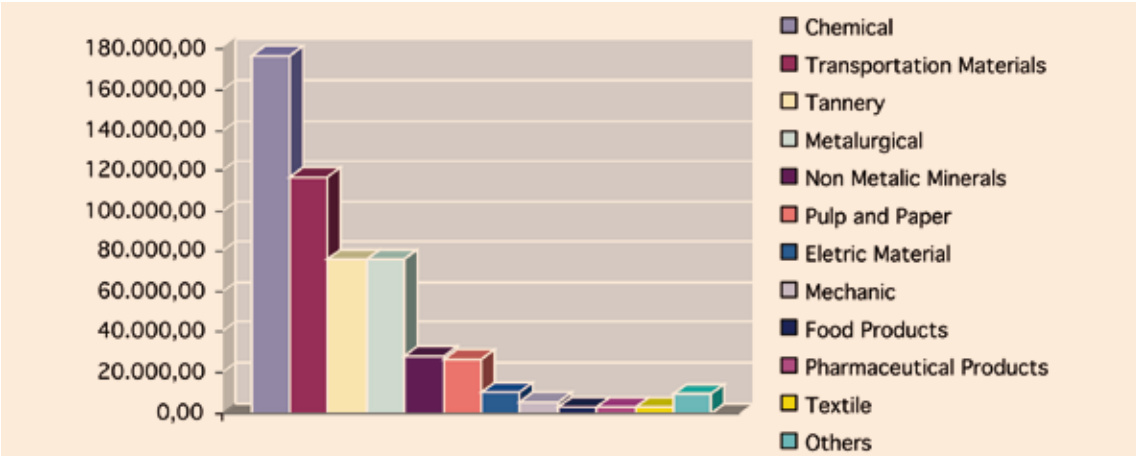


Figure 11 – Amount of Industrial Hazardous Solid Waste generated in Sao Paulo State by industrial sector (CETESB, 1997)

In Brazil, there are 12 hazardous waste incineration plants selling their services. In Sao Paulo State, there are four plants that receive wastes from Sao Paulo and other states of Brazil, as shown on Figure 14. The incineration plants in Sao Paulo State are not allowed to burn PCBs and PCBs wastes, that usually have been sent to other incineration plants in Brazil, such as Tribel - Belford Roxo Industrial Solid Waste Treatment of Rio de Janeiro State, Cetrel - Gravatá Industrial Liquid Effluent Treatment of Bahia State or Cinal - Alagoas Industrial Company of Alagoas State, respectively placed in Rio de Janeiro, Bahia and Alagoas State (that are the ones that have permit for burning this kind of wastes). There are 16 permitted landfills units for disposal of industrial hazardous wastes in Brazil, four of which are located on Sao Paulo State, as shown on Figure 15.

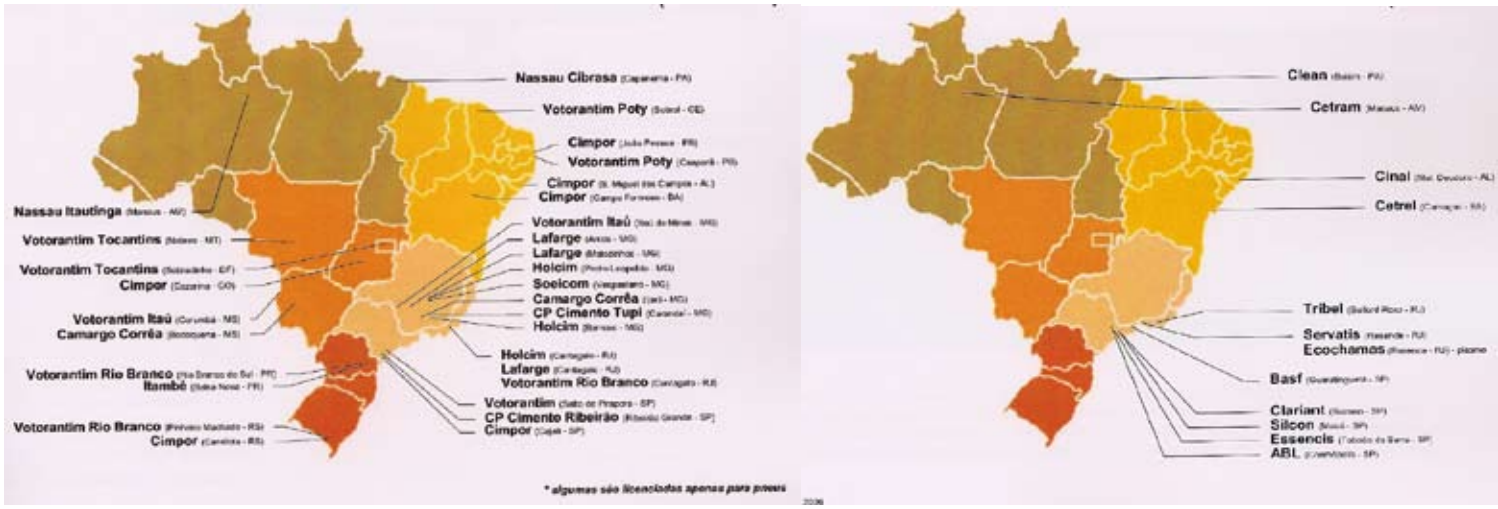


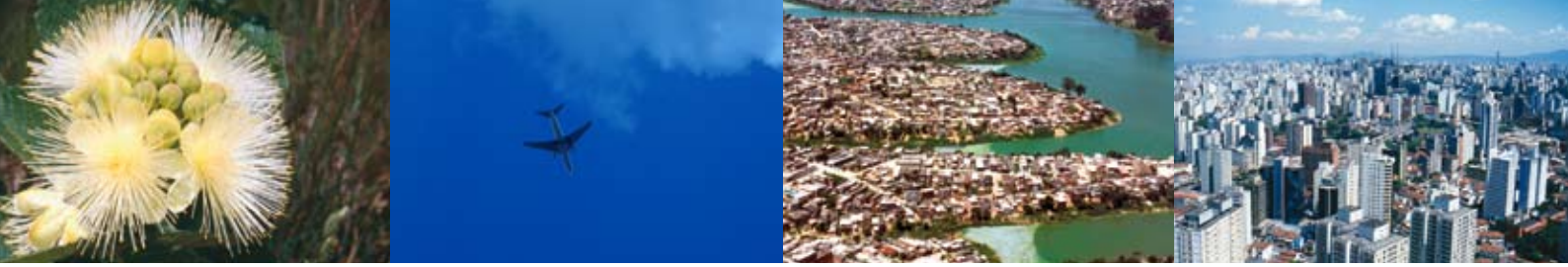
Figure 12. Location of Cement kiln Plants (ABETRE, 2006)*

Figure 13. Offsite Blending Plants for Cement Kiln Waste Processing (ABETRE, 2006)*

Figure 14. Location of Incineration Plants Permitted For Burning Hazardous Wastes (ABETRE, 2006)*

Figure 15. Location of Hazardous Wastes Landfills Sites (ABETRE, 2006)*

* ABETRE – Brazilian Association of the Wastes Treatment Companies



Pesticides Empty Containers, Used Lubricating Oil and Equipment containing PCB

Pesticides empty containers as well as used lubricated oil have appropriate legislations that are under post-consumption responsibility. Each sector implemented a successful network for collecting, transporting, treating, recycling and disposing of these wastes. As a result, environmentally sound lubricating oil recycling systems have been established in the State of Sao Paulo.

In Brazil there are two facilities for PCB waste recycling as well. One plant is located in Sao Paulo State and another in Paraná State, both of them provide the clean up of capacitor and transforms allowing the recovery of spare parts that can be recycling and send to be burnt in off-site incineration plants the ones that can not recovered.

• Environmental Emergencies and Health and Environment Risk Assessment

CETESB has developed expertise in various activities to prevent and/ or to minimize environmental impacts and risks to public health caused by environmental accidents. In 2008, CETESB attended 451 environmental emergencies caused by chemical products and it coordinates the REQUILAC Network.

For further information, visit the site http://www.cetesb.sp.gov.br/Emergencia/emergencia.asp

Risk assessment is an important tool to evaluate and to characterize potential polluters and select activities to be controlled and licensed, and to prevent environmental accidents.

For further information see the site http://www.cetesb.sp.gov.br/Emergencia/riscos/apresentacao/introducao.asp




• Transfer of Environmental Technology

In 2008, CETESB offered 209 training courses and practical trainings courses involving an audience of 1,333 participants from Brazil and Latin America. These courses are intended to provide technical information and support to different institutions.

In order to promote technology transfer to environmental agencies of the Latin America and the Caribbean Region, the Centre can offer courses to decision makers, managers and personnel responsible for the POPs sectors. The trainings are the following ones:

- Cleaner Production: a tool for sustainability/ Capacity-building based on BAT and BEP guidelines;
- Air pollution control and air quality monitoring: inventory, sampling, analyses, technologies for particulate, gases, fumes, odour and POPs
- Procedures for the management of contaminated sites and techniques for investigation of POP contaminated sites
- Response actions for chemical emergencies.
- Environmentally sound management of Hazardous Industrial Solid POPs waste: source reduction and minimization practices, legislation, inventory, identification, labeling, characterization, classification, temporary storage, environmental management of terrestrial transport and treatment and disposal techniques
- Medical solid waste management: source reduction and minimization practices, legislation, characterization, classification, treatment and disposal techniques
- Urban solid waste management: minimization, reduction and elimination of unsafe disposal.
- Sampling and preservation of water, sediment and organism samples for POPs monitoring.
- Analysis of Persistent Organic Compounds (PCBs and OCP) in environmental samples
- Health and Environment Risk Assessment.
- Assessment of environmental, social and economic impacts generated by pollution sources for permitting.
- Clean Development Mechanism (CDM) of the Kyoto Protocol.

Library

CETESB has a library with approximately 37,000 publications and it is the most specialized and complete library in environmental pollution in Latin America, with more than 22 thousand consultations per year, reaching more than 6,000 users in 2008 and it coordinates the REPIDISCA - Pan American Network of Information in Environment.

Organization of Workshops, Seminars and Conferences





• International Cooperation And Environmental Networks

CETESB has also cooperation agreements with the World Bank, United Nations Development Program - UNDP, United Nations Environment Program - UNEP, Pan American Health Organization - PAHO, U.S. Environmental Protection Agency - EPA, Inter-American Development Bank - BID, International Bank for Reconstruction and Development - BIRD, Agency of Commerce of the United States –TDA, The German Federal Environment Agency –UBA, Environment Canada, Japan International Cooperation Agency -JICA, the Ministry of Science and Technology of the British Government and Ministry of Environment of Brazil.

CETESB participates in five international networks:

- RELASC - Latin-American Prevention and Control of Soil and Groundwater Contamination: CETESB is coordinating the implementation of a regional networking enterprise supported by public and private organizations, whose main purposes are to stimulate and give support to the production, diffusion and sharing of systematized knowledge and information on soil and groundwater contamination prevention, remediation, hazardous waste cleanup, and brown fields redevelopment. So far, only Argentina, Brazil, Chile, Mexico and Uruguay are taking part in the networking project.
- REQUILAC - Latin American and Caribbean Chemical Emergency Response Network – PAHO- WHO
- SPC - Sustainable Production and Consumption Information Network For Latin America And The Caribbean – under UN's Marrakech Process
- REGIONAL GOVERNMENTS FOR SUSTAINABLE DEVELOPMENT
- RELAC - (Network of Environment and Health Laboratories for Latin America and Caribbean): CETESB is a member of RELAC, a regional forum of interchange, analysis and information dissemination in quality assurance for environment and health laboratories. It is administrated by CEPIS (PAHO/WHO) and counts on professionals of all Latin America and the Caribbean region that give support to each other in different analytical areas.

• Legislative Text, Regulatory, Directives And Policies Elaboration

CETESB has an effective participation in the elaboration of National Environmental Council and state legislation. In the annex, there are some directives related to management of solid waste containing POPs of Stockholm Convention such as: solid waste characterization, pollution control, transportation and storage, treatment and disposal, mainly incineration of hazardous waste and health services, coprocessor residue in furnaces and boilers, cremation and any heat treatment of waste which has potential emission of dioxins and furans, landfills, empty pesticides containers, used lubricated oil and PCBs destruction and destination.

APPENDIX

Contaminated Sites Management

- ABNT NBR 15515-1, 2007 – Environmental passive in soil and groundwater
  Part 1: Preliminary assessment.
- ABNT NBR 15492, 2007 – Boring wells for environmental analysis – Procedures.
- ABNT NBR 15495-1, 2007 – Groundwater monitoring wells for granular aquifers
  Part 1: Design and construction.
- ABNT NBR 15495-2, 2007 - Groundwater monitoring wells for granular aquifers
  Part 2: Development.

Solid Waste Characterization

- ABNT NBR 10004, 2004 – Solid Waste – Classification
- ABNT NBR 10005, 2004 – Leaching Test – Procedures
- ABNT NBR 10006, 2004 – Solubility Test – Procedures
- ABNT NBR 10007, 2004 – Sampling of solid waste
- ABNT NBR 12988, 1993 – Paint filter test – Method of test

Pollution Control – General

- CONAMA Resolution No. 396 of 03 April 2008 - Concerning groundwater classification
- State of Sao Paulo Decree No. 8.468 of 08 September 1976 – Environmental Pollution Control and Prevention regulates Act n. 997.
- State of Sao Paulo Act No. 997 of 31 May 1976 – Environmental Pollution Control
- State of Sao Paulo Act no. 12.300 of 16 March 2006 - Enacts the state policy on Solid Waste and defines principles and guidelines.
- State of Sao Paulo SMA nº 42 of 29 December 1994 - Environmental Impact Assessment Analysis Procedures.
- CONAMA Resolution No. 1 of 23 January 1986 - Environmental Impact Assessment Content, Responsibilities and other requirements.
- CONAMA Resolution No 313 of 29 October 2002 – National Industrial Solid Waste Inventory.

Transportation and Storage

- ABNT NBR 12235, 1992 - Dangerous goods – Storage of dangerous solid substances – Procedure.
- ABNT NBR 11174, 1990 - Solid classes II and III – non hazardous waste-storage – Procedure.
- ABNT NBR 13221, 2007 - Waste Transportation.
- Federal Decree No. 875 of 19 July 1993 – Concerning the Control of Transboundary. Movements of Hazardous Wastes and their Disposal (Basel Convention)
- CONAMA Resolution No. 23 of 12 December 1996 - Control of Transboundary. Movements as of Hazardous Wastes and their Disposal.
- Federal Decree No. 4.581 of 27 January 2003 – Amendments on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention).

Solid Waste Treatment and Disposal

- ABNT NBR 8418, 1983 - Hazardous waste landfill - Project presentation – Procedure.
- ABNT NBR 1015, 1987 - Hazardous waste landfill – Project, building and operation criteria – Procedure).
- ABNT NBR 8419- 1992 – Urban solid wastes landfill – Project presentation – Procedure.
- ABNT NBR 13896-1997 - Solid wastes landfill – Project, installation and operation criteria – Procedure.

- ABNT NBR 12553-2003 - Geosynthetics – Terminology.
- CONAMA Resolution No. 264 of 26 August 1999 – Permitting of clinker cement kiln's activities regarding wastes co-processing.
- CONAMA Resolution No. 316 of October 2002 – Criteria and Procedures for burning and thermal treatment of wastes.
- P4.263/2003 -- Use of waste in cement kilns – Procedure.
- ABNT NBR 11175, 1990 - Solid hazardous waste – Equipment for incineration – Performance standard – Procedure.
- CONAMA Resolution No. 5 of 03 August 1993 - Solid waste from health care establishments, ports and airports.
- CONAMA Resolution No. 281 of 12 July 2001 – Treatment and disposal of medical waste.
- CONAMA Resolution No. 358 as of April 29, 2005- Medical waste generators permitting
- State of Sao Paulo Joint Resolution No.1 of 29 June 1998 - Guidelines and Technical Requirements for Medical Waste Management.
- State of Sao Paulo Joint Resolution No. of 15 July 2005 - Classification, guidelines and technical requirements for animal infectious wastes.
- E15.011 – Medical waste incineration system procedures.
- E15.010 – Non-combustible thermal treatment for infectious wastes.
- P2.111 – Evaluation of the effectiveness of non-combustible thermal treatment for infectious waste by means of bioindicators test.
- P4.262 – Chemical waste management from health care establishment.

Empty Pesticides Containers

- ABNT NBR 13968, 1997 – Rinsing procedures of empty pesticide rigid containers
- ABNT NBR 14719, 2001 - Final disposal of rinsed empty pesticide rigid containers – procedure
- ABNT NBR 14935, 2003 - Final disposal of unrinsed empty pesticide containers – procedure
- Federal Law No. No 7.802 of 11 June 1989, altered by Federal Law N 9974/2000, regarding pesticides control, regulated by Federal Decree No. 4.074 of 04 March 2002.
- CONAMA Resolution No. 334 of 03 April 2003 – Pesticides empty containers permitting
- State of Sao Paulo SMA Resolution No. 7 of 31 January 2006 – Concerning preliminary permitting of empty containers handling units.

Used Lubricated Oil

- CONAMA Resolution No 009 of 31 August 1993
- CONAMA Resolution No 362 of 23 June 2005 – Concerning collection and disposal of used and contaminated lubricating oil.

PCBs Destruction And Destination

- ABNT NBR 13741, 1996 – PCB's destination - Procedures
- ABNT NBR 8371, 2005 – Askarels for transformers and capacitors
- ABNT NBR 13882, 2005 – Electrical Isolating Liquids – Determination of PCBs contents
- Interministerial Regulation MINTER/MIC/MME No. 19 of 29 January 1981 – Prohibition of PCBs production.
- Joint Standard Regulation SEMA/STC/CRS No. 1 of 10 June 1983 – Concerning PCBs and PCB containing wastes handlings and storage.
- CONAMA Resolution No. 19 of 19 September 1994 – Concerning waste transboundary movement exception to PCBs contaminated waste.
- State of Sao Paulo Act No. 12.288 of February 2006 - Concerning the elimination of PCBs.

Main Acronyms

- CONAMA – National Environmental Council
- CETESB – Environmental Agency of State of Sao Paulo
- ABNT NBR – Standards from ABNT – Brazilian Technical Standard Association
- SMA – State of Sao Paulo Environmental Secretariat

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Air Quality Report. CETESB. 2008

Water Quality Report. CETESB. 2008

Handbook of Management of Contaminated Sites, CETESB.1999.

Guiding Values for Soils and Groundwater, CETESB. 2001 and updated in 2005 .

Procedure for Management of Contaminated Sites CETESB. 2007.

Soil quality condition of the Alto Tiête´s Watershed Region. CETESB. 2008.

Corrective Action Based on Risk (ACBR) Applied to Areas Contaminated with Hydrocarbons Derived from Oil and Other Liquids Fuels - Procedures – CETESB.2000 and revised in 2006.

Guide for Assessment of Potential Contamination in Buildings. CETESB.2003.

Sao Paulo State Inventory of Urban Solid Waste. CETESB.2008

Sao Paulo State Inventory of Industrial Solid Waste. CETESB.1997.

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Stockholm Convention on persistent organic pollutants (POPs)

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