

## **COUNTRY REPORT – BRAZIL**

### **Best Available Technique (BAT) and Best Environmental Practice (BEP) under the Context of United Nations Industrial Development Organization (UNIDO)**

**Vitor Sousa Domingues**

Environmental Analyst

Coordination of Environmental Control of Hazardous Substances and Products

Environmental Quality Directory

Brazilian Institute of the Environment and Renewable Natural Resources (Ibama)

Ministry of the Environment

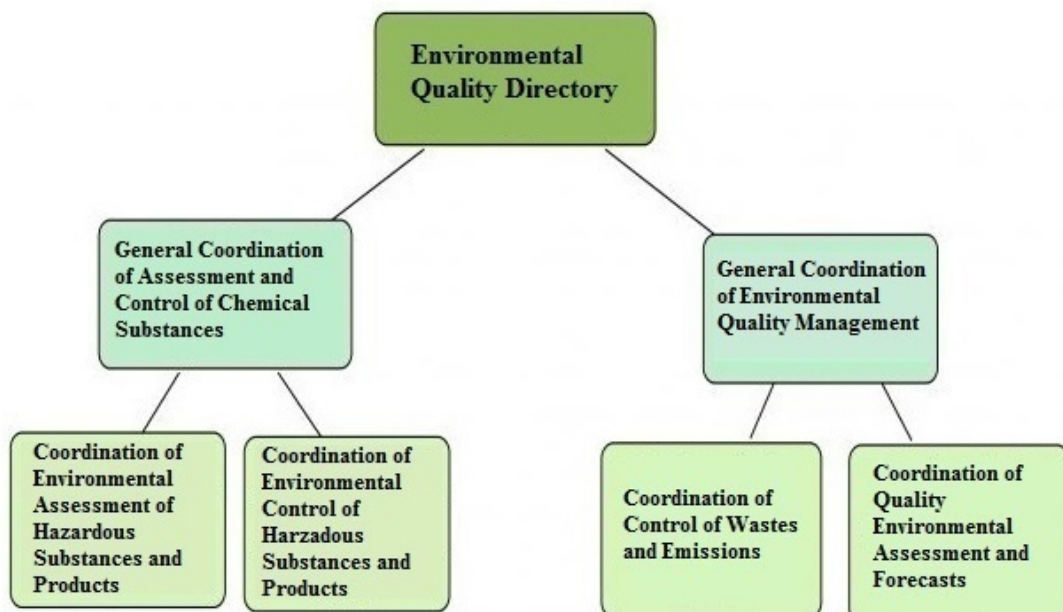
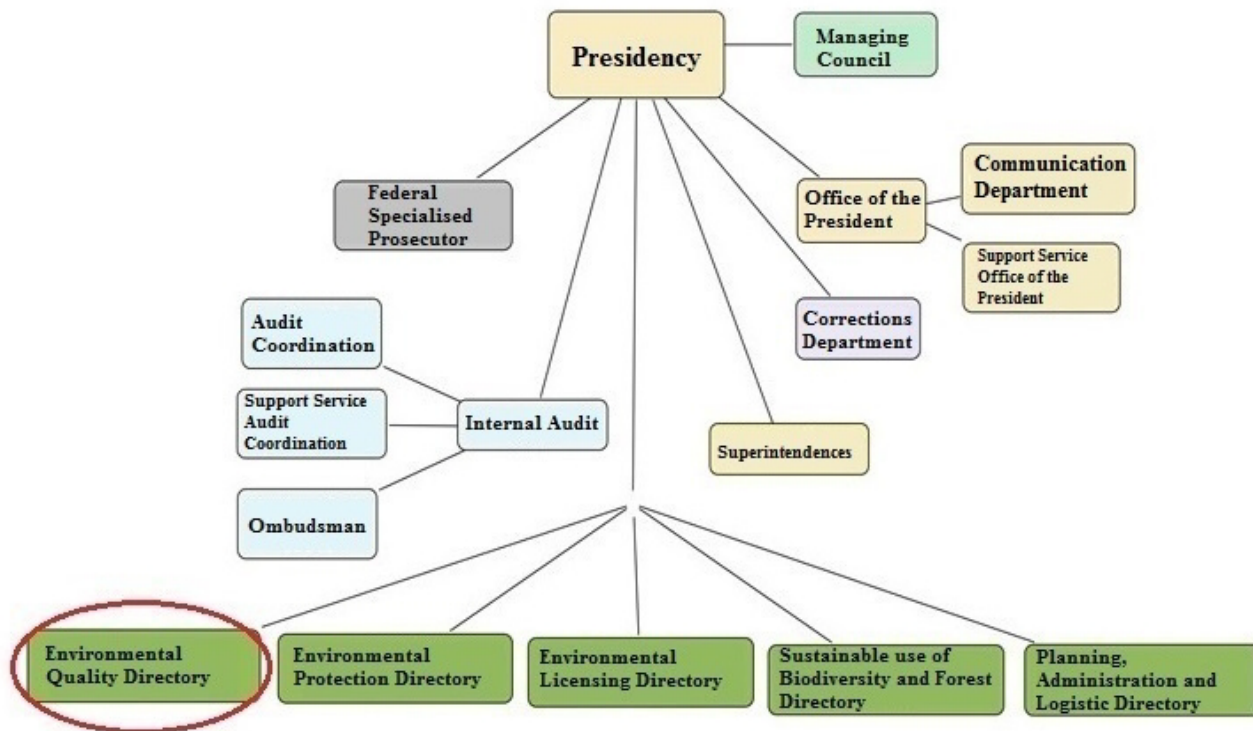
**Federative Republic of Brazil**

**Ibama** is the national agency responsible for executing the National Policy for the Environment, promoting the conservation of the environment and controlling and supervising the natural resources use.

The **Environmental Quality Directory** of **Ibama** must coordinate, control and execute federal actions regarding the criteria, parameters and indicators for maintaining environmental quality.

As an environmental analyst at the **Environmental Quality Directory**, improving the thresholds and the parameters for monitoring the substances listed in the Stockholm Convention is an attribution of mine, besides controlling the entrance of these substances in Brazil.

# Ibama - Organization Chart



## GENERAL INFORMATION - BRAZIL

Brazil is the fifth largest country in the world by land area, presenting 8,514,976.60 km<sup>2</sup>. Placed in South America, the territory occupies 47% of the continent and share a border with 11 of the 13 South American nations. Brazil has also a coastline of 7,367 km, bounded by the Atlantic Ocean.

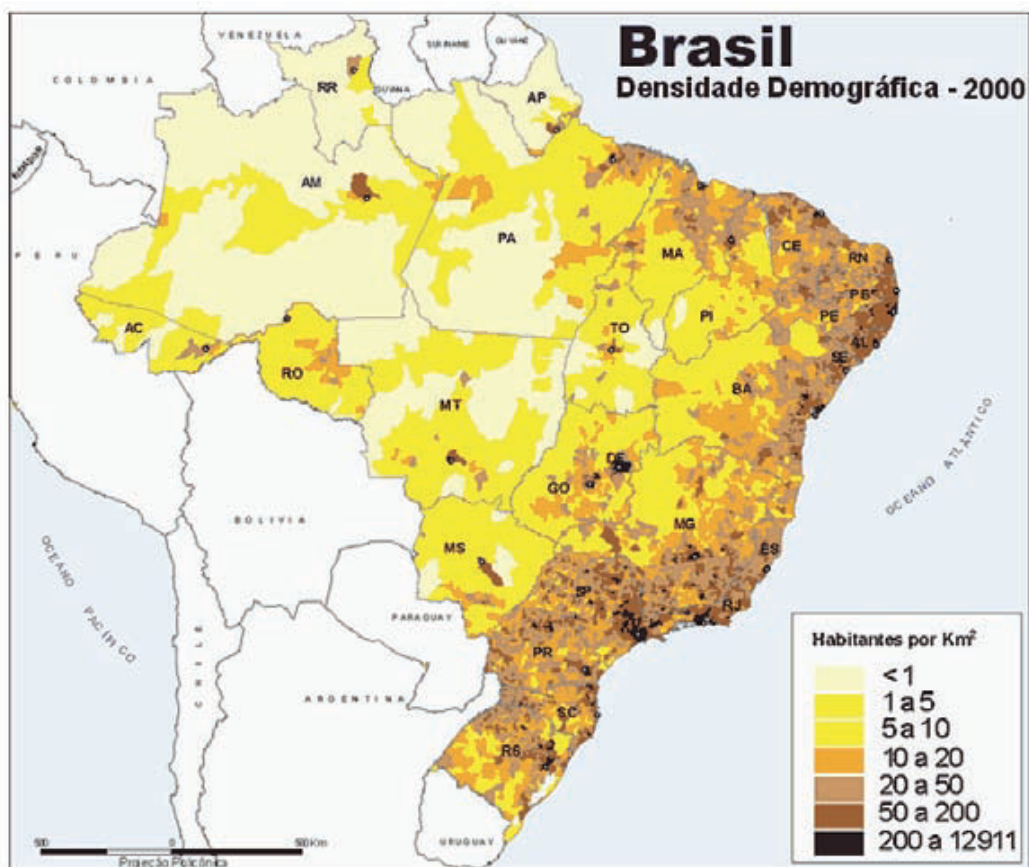


IBGE <[https://atlascolar.ibge.gov.br/images/atlas/mapas\\_brasil/brasil\\_politico.pdf](https://atlascolar.ibge.gov.br/images/atlas/mapas_brasil/brasil_politico.pdf)> Access in 09.20.2017

The federation is composed of 27 federal units and 5,561 municipalities. Brazilian population is estimated at 208,007,000 inhabitants and the country is the sixth most populous in the world. In 2010, 84.35% of the population were living in urban centres, while 15.65% were rural families. Brazilian population is also unequally distributed along the territory, once 42.1% of the people are concentrated in the Southeast region, while 27.8% are in the Northeast, 14.4% in the South, 8.3% in the North and 7.4% in the Central-West.

Brazil has an HDI of 0.754 and is the world seventh largest economy by gross domestic product and farming represents around 6.7% of the national economy. The main agriculture products are sugar cane, soy, maize, cassava and orange. Chicken meat, sugar, tobacco, soy, soy oil and beef cattle correspond to the Brazilian greatest market share.

Brazilian industrial production was responsible for 2.4% of the gross domestic product. Mineral extraction industry and transformation industry are very diversified, but are not well distributed along the country.



IBGE, 2002 <[http://www.ibge.gov.br/ibgeteen/atlasescolar/mapas\\_pdf/brasil\\_distribuicao\\_industrias.pdf](http://www.ibge.gov.br/ibgeteen/atlasescolar/mapas_pdf/brasil_distribuicao_industrias.pdf)> (Access at 4.20.2011)



Brazilian landscape is composed by six main biomes: Amazon Forest, Cerrado, Caatinga, Atlantic Forest, Pantanal and Pampa. The current forest cover corresponds to 69% of the original coverage. Brazilian forests represent 28% of the total global forests.

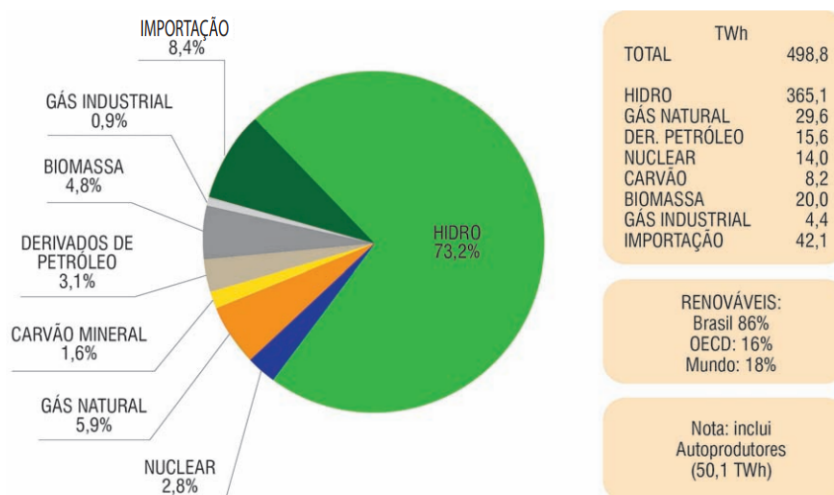
Biome	Area (km <sup>2</sup> )	Participation (%)
Amazon	4.196.943	49.29
Cerrado	2.036.448	23.92
Athlantic Forest	1.110.182	13.04
Caatinga	844.453	9.92
Pampa	176.496	2.07
Pantanal	150.355	1.76



IBGE, <[www.ibge.gov.br/home/presidencia/noticias/noticia\\_visualiza.php?id\\_noticia=169](http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=169)> (Access at 04.30.2011)

Finally, Brazil presents one of the most clean and renewable energy matrices in the world. In 2008, 73% of the energy, in the country, came from hydroelectric power stations.

**Figura 8 Matriz de oferta de energia elétrica em 2008**



Brazilian legal framework includes federal, states and local laws. There are forums and commissions like National Council of the Environment (CONAMA), in order to guarantee the social participation in the definitions of policies. In addition, the federal or state agencies can establish specific normative instructions regarding the safety in the production, trade, use and disposal of chemicals. But states and municipalities can only make their own rules if they respect the federal ones or just in the case when there is no existing rule at the federal level. The local governments legislation can be more restrictive than the federal rules, but never less.

These information are important for the understanding the national context in which PCDD/PCDF releases are inserted and why Brazil presents a very particular template of distribution of the emissions.

# OVERVIEW, BACKGROUND AND FUTURE TRENDS

## INVENTORY

Due to its diversified industrial park, strong farming activity and large land area, Brazil presents also variable PCDD/PCDF sources of emission or accumulation.

The inventory performed by the Brazilian government for identifying and estimating PCDD/PCDF releases was achieved according to the UNEP document *Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases* (Toolkit 2005). The inventory was published in 2013, but its reference year is 2008.

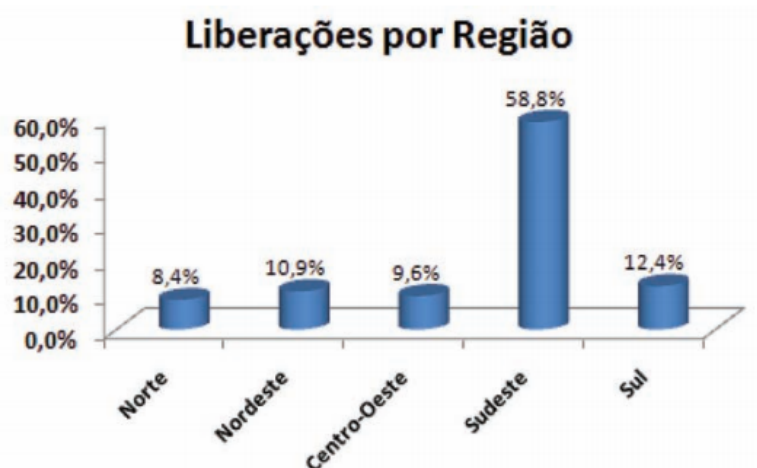
According to the inventory, in 2008, there was a release of **2.235 g TEQ** of dioxin and furans. 52.3 % of these compounds were released in the air, followed by a 24.4 % in the residues and a 18.7 %, in the products. Activities of interest were grouped in categories and are presented in Table 1, followed by the participation of each one in the total releases.

**Table 1**

Category	Description	Annual Releases (g TEQ/year)						Participation (%)
		Air	Water	Soil	Product	Waste	Total	
1	Waste incineration	72.8	-	-	-	38.7	111.5	5.0
2	Metal industry	557.4	0.4	-	-	296.8	854.6	38.2
3	Power generation	41.6	-	-	-	11.6	53.2	2.4
4	Mineral products	54.4	-	-	9.1	7.2	70.7	3.2
5	Transport	8.3	-	-	-	-	8.3	0.4
6	Open burning	430.0	-	79.0	-	-	509.0	22.8
7	Chemicals and consumer goods	2.7	10.5	-	356.4	21.3	390.8	17.5
8	Miscellaneous	0.9	-	-	-	2.7	3.7	0.2
9	Disposal	-	12.1	-	53.1	168.0	233.2	10.4
	<b>Total</b>	<b>1,168</b>	<b>23</b>	<b>79</b>	<b>419</b>	<b>546</b>	<b>2,235</b>	<b>100.0</b>
Participation (%)		52.3	1.0	3.5	18.7	24.4	100.0	
Per capita emission (µg-TEQ/year)		6.1	0.1	0.4	2.2	2.9	11.8	

There is a huge difference in PCDD/PCDF releases between Brazilian regions. Southeast region, due to a much larger population, high industrialization levels and a strong farming activity, corresponds to 58.8 % of the total releases. In this region, the outstanding activity which is not so expressive in the other regions is the metal industry. In congruence, the state of São Paulo, the most populous and the most industrialized one, is responsible for 28.9 % of the total Brazilian emissions, followed by Minas Gerais and Rio de Janeiro.

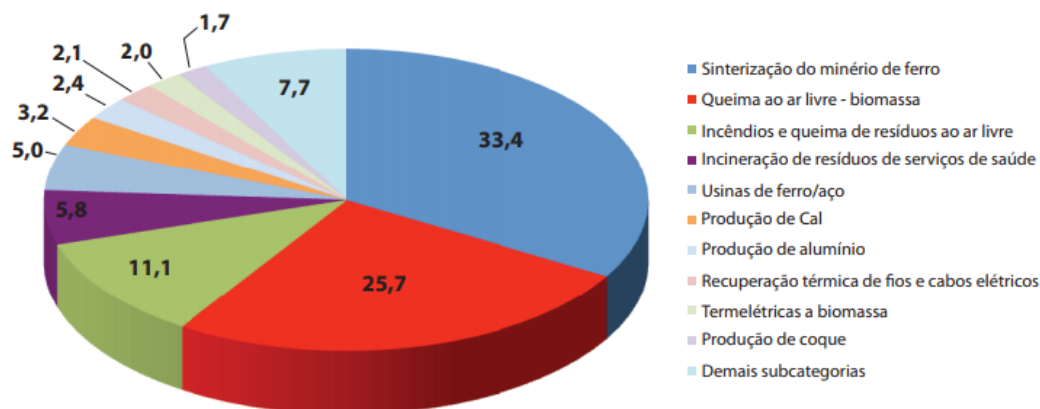
**Figura 34 - Participação relativa (%) das grandes regiões brasileiras nas liberações estimadas para o ano de 2008**



Metal industry was responsible for 47.7 % of air releases, but open air burning reached also an expressive rate of 36.8 %. In the third position, waste incineration corresponded to 6.23 % of the emission in this medium.

Iron ore sintering was the activity which discharged most of the releases in the air. But biomass burning, especially sugarcane burning, and fires and waste dumps also play a significant role in air emissions in Brazil.

**Figura 32 - Participação relativa (%) das subcategorias no meio ar, em 2008**

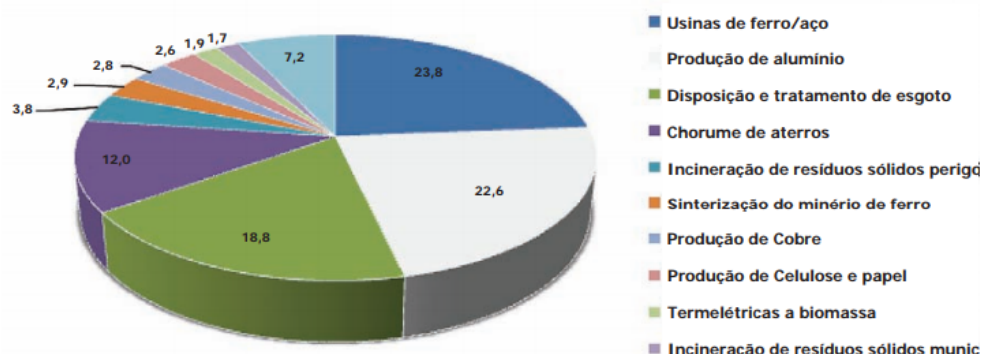


Metal industry was also the main source of the releases in wastes, corresponding to 54.3 % of the releases in this category, followed by disposal of effluents and wastes (30.8 %) and incineration of wastes (7.1 %).

Iron and steel production and foundries and aluminum production were the major responsible for the releases in waste. Sewage and slurry also represented substantial categories.



**Figura 33 – Participação relativa (%) das subcategorias (fontes) no meio resíduo, em 2008**



Concerning PCDD/PCDF releases in products, chemical and consumer goods production amounted 85.1 %. Disposal corresponded to 12.7 % and mineral industry to 2.2. The three activities represent 100 % of the releases in this media.

Leather industry is the main responsible for PCDD/PCDF releases in products, reaching more than 60 % of the total. Composting, textile industry and pulp and paper production play a minor role.

Unfortunately not all the data employed in the analysis comes from reliable sources. There is a lack of information and hindrances in obtaining data from state bodies, the major responsible for licensing and inspecting the activities. Thus, the inventory was performed conservatively.

Metal industry, open burning, chemicals and consumer goods production and disposal of wastes were highlighted activities in the analysis. So, the releases reduction must be a priority in these areas.

As the control of PCDD/PCDF in air, water and in products tend to be more efficient if compared to the control in residues, the Brazilian plan of action focused on these media. Brazil also presents hindrances in detecting, quantifying and, so, monitoring these substances. So, the plan of action also took into account the limitations regarding the availability of techniques and laboratories and the high cost of the analysis.

## PLAN OF ACTION

### Iron ore sintering

Iron ore sintering activity corresponds to 18.17 % of the total releases, being 96 % through air emissions and 4 % through the residues. Brazil is the ninth greatest steel producer in the world and the metal industry plays an important role in Brazilian economy.

In some systems, a percentage of residues may be added to the iron ores. 50 % of the power plants which perform the sintering don't specify the origin of the

residues added to the iron ores. Material may also be contaminated with oil. The other 50 % has a control of the residues employed.

For the current releases, the Best Environmental Practices must be adopted and the monitoring of the sources must be performed. New sources must be also fit into the Best Available Techniques and Best Environmental Practices.

Among the measures which could avoid PCDD/PCDF releases in this activity are the steady operation of the sintering plant, the continued monitoring, recirculation of residual gases, the fine control of the particulate matter and the control of the input materials, that should not be contaminated with POPs. Charcoal filtration, urea addition and gas scrubber treatments may assist in reducing PCDD/PCDF formation.

Brazil presents two resolutions regarding the emission of gaseous residues that limit the amount of particulates discharged. Fabric filters are recommended.

However, PCDD/PCDF threshold values for the emissions must be established in legislation and the use of the Best Technology Available must be required. The implementation period was fixed in 5 years.

Monitoring must also be established through a normative and an analysis protocol must be published.

The expected reduction rate is of 53.9 %.

### **Biomass open burning**

Biomass open burning corresponds to 15.06 % of the total PCDD/PCDF releases. 89.3 % of the releases are discharged in the air, while 10.7 %, in the soil.

The open burning is also an expressive source of emissions in Brazil. Agriculture residues burning is a common practice, especially sugarcane burning, which reduce sharp leaves that could hurt rural workers and frighten venomous animals.

Sugarcane burning corresponds to 33 % of the total biomass open burning in Brazil. São Paulo state published a law prohibiting the sugarcane straw burning. Minas Gerais and Goiás also published protocols for reducing the practice, but these experiences must be extended to the entire country.

Forest fires are also common in Brazil and present a seasonal behaviour, mainly in the Cerrado. Most of the fires occurring in Brazil are anthropic and illegal. There are already laws regarding vegetation protection against fires and burning control policies are responsibility of the states.

It is important to emphasize that the use of chlorinated pesticides enhance the releases of PCDD/PCDF in these occasions. The main pesticide used in Brazil which production is related to the emission of PCDD/PCDF is the herbicide 2,4-D.

Satellite monitoring is well developed in Brazil and acts as an important tool for identifying fires. Municipal government must also be involved.

The expected reduction rate is of 50 % and the implementation period was fixed in 5 years.

### **Waste burning and accidental fires**

Waste burning and accidental fires correspond to 7.72 % of the total PCDD/PCDF releases, being 75.4 % discharged in air and 24.6 % in the soil.

Urban fires must also be controlled. In this case, the community participation is especially important. Thus, people education and awareness is a very relevant measure, as the agreements with municipal government and fire brigades. Landfill control and biogas collection is also relevant.

The expected reduction rate is of 30 % and the implementation period was fixed in 5 years.

### **Medical waste incineration**

Medical waste incineration corresponds to 3.41 % of the total PCDD/PCDF releases, being 88.5 % of the discharges in air and 11.5 % in the residues.

Waste incineration processes are not widely employed in Brazil, especially for domestic waste. Only 0.038 % of this type of residue is incinerated. On the other hand, hazardous waste and healthcare waste correspond to a little fraction of the total waste produced in Brazil, but the incineration is performed more often and in more controlled and sophisticated plants.

In this process, Best Environmental Practices must be adopted in all units. Emissions thresholds must also be established in laws. The current limits required for thermal treatments must be reduced.

However, Best Available Techniques and Best Environmental Practices are expensive for medical waste incineration, especially for little volumes. Thus, medical waste screening should be performed, once it reduces significantly the volume of incinerated waste. Waste management could also reduce the volume of residues produced.

Periodical monitoring must also be predicted in the legislation.

The expected reduction rate is of 77 % and the implementation period was fixed in 5 years.

### **Iron and steel production**

The iron and steel production corresponds to 8.4 % of the total PCDD/PCDF releases. 30.3 % discharged in the air and 69.2 % in the residues.

As for iron ore sintering activities, for the current releases, the Best Environmental Practices must be adopted and the monitoring of the sources must be performed. New industries must be also fit into the Best Available Techniques and Best Environmental Practices.

In steel and iron mills, residues may also be added to the product. Steel production in Brazil is expressive and most of the mills employ fabric filters and also control POP emissions. However, the model of estimation proposed by UNEP doesn't consider the emissions arising from mills which use charcoal.

The inputs employed in secondary production must be strictly controlled, minimizing oil, plastic or other hydrocarbons. It is also important to perform a

controlled operation of the system, frequently monitor the system parameters and efficiently treat the emissions.

The expected reduction rate is of 15.8 % and the implementation period was fixed in 5 years.

### **Lime production**

Lime production corresponds to 1.67 % of the total PCDD/PCDF releases and 100 % of the emissions are in the air.

Threshold values must be established for the emissions in this activity, as efficient treatment systems must be required. Periodical monitoring must also be adopted for medium and large plants.

The expected reduction rate is of 79 % and the implementation period was fixed in 5 years, with gradual requirements.

### **Aluminum production**

Aluminum production corresponds to 6.79 % of the total PCDD/PCDF emissions, being 18.5 % in the air and 81.5 % in the residues.

For aluminum production, most of the processes regard pure primary aluminum. But Brazil also shows an expressive thermal processing, due to can recycling. Half of the recycling material is treated.

Secondary aluminum production has a high potential to release dioxins and furans, once aluminum acts as a catalyzer and the aluminum waste may be contaminated. Thermal scrap treatment is the major process responsible for the emissions.

Thus, there must be a control of the input material, a choice for new technologies that prevent PCDD/PCDF formation, a strict control of the process and its stability, and an efficient treatment of the gas emissions. Best Environmental Practices must be required for this process and Best Available Techniques must be proposed for scrap melting, always considering the national conditions.

Finally, a periodical monitoring must be established.

The expected reduction rate is of 84 % and the implementation period was fixed in 5 years, with gradual requirements.

### **Thermal wire reclamation**

Thermal recovery of electrical cables corresponds to 1.1 % of the total PCDD/PCDF releases, all discharged in the air.

The open burning of copper wires in Brazil is already illegal and corresponded to 98 % of the estimated thermal wire reclamation. Most of the material comes from thefts.

The Ministry of the Environment published a handbook with good practices in the sector. Then, the import of cables which went through this process must also be prohibited.



Threshold values for the emissions of the current units must be adopted, as gas emission control treatments, following the Best Available Techniques under the national context.

The expected reduction rate is of 73.3 % and the implementation period was fixed in 5 years, with gradual requirements.

### **Pulp and paper production**

Pulp and paper production corresponds to 2.85 % of the total PCDD/PCDF releases.

The main activity of the chemical industry which acts as a source of PCDD/PCDF emission are pulp and paper production, once Brazil is the fourth greatest producer of cellulose in the world. Paper recycling is also an expressive activity. 98 % of the paper produced in Brazil employs cellulose from *Eucalyptus* and *Pinus* trees.

Elemental chlorine, responsible for PCDD/PCDF formation, is being eliminated from the pulp and paper production. Importers, which deal with Brazilian industries, claim for elemental chlorine free products. Thus, releases from this source will probably cease soon. Monitoring must, so, be performed for verifying the improvements.

The main Best Available Techniques and Best Environmental Practices regard eliminating elemental chlorine and replacing it with chlorine dioxide. Input precursors may also be reduced in the process, as the raw materials contaminated with polychlorinated phenols.

The expected reduction rate is of 50 % and the implementation period was fixed in 5 years.

### **Open water dumping**

Wastewater disposal in water bodies corresponds to 0.45 % of the total PCDD/PCDF emissions. PCDD/PCDF are not expected to be formed in the wastewater, so it is supposed that these pollutants come from the activities which generate the wastewater.

These releases come from all the activities which produce PCDD/PCDF and discharge the effluents in open water, including the gas emission treatments.

Brazilian legislation forbid the release of wastewater containing dioxin and furans in water bodies without an efficient treatment.

Best Available Techniques and Best Environmental Practices must be adopted, as the monitoring in the wastewater treatment systems.

The expected reduction rate is of 63 % and the implementation period was fixed in 5 years.

### **Leather and textile industry**

Leather industry corresponds to 11.34 % of the total PCDD/PCDF releases, all of it in the product. Brazil is the second greatest producer of bovine leather. Textile industry corresponds to 2.33 % of the total PCDD/PCDF releases, all of it in the product too.

The PCDD/PCDF releases from leather and textile industry comes from contaminated inputs, especially dyes or biocides whose base is a chlorinated molecule. Chlorinated pesticides are employed in cotton production and other chlorinated products may be used in the finishing processes and leather refining. After the product treatment, some of these substances are discharged in the wastewater. The substitution of these compounds is a good alternative.

Thus, the recommendation is to not using contaminated inputs and monitoring the imported materials and the wastewater. Besides that, minimal threshold values must be established and a handbook with good practices in the sector should be published. The control of the industrial processes are also an important Best Environmental Practice.

Textile and leather burning must be avoided.

The expected reduction rate is of 97 % and the implementation period was fixed in 5 years.

### **Thermal power plants**

Near 16.3 % of the Brazilian energy comes from thermal power stations. The main boiler fuels are light oils, natural gas and diesel, but biomass has also an expressive counterpart.

Thermal power plants represent an emerging source of releases which should be closely monitored for avoiding uncontrolled discharges and ensuring a periodical monitoring. Thermal power plants corresponds to 1.49 % of the total releases.

### **Conclusion**

For the PCDD/PCDF air releases, the expected decrease is 49.3 % when implementing the plan of action. This rate corresponds to 25.8 % of the total emissions.

For water releases, the expected decrease was estimated in 67.4 %, which corresponds to 0.7 % of the total.

For the products, adopting the measures proposed for leather and textile industry, the reduction is estimated in 70.5 %.

Employing the plan of action, in five years, the estimation of the decrease in the PCDD/PCDF total release is of 45.5 %.

## **BRAZILIAN LAWS AND REGULATIONS**

Brazilian legislation regards food and farming products and the environment.

Dioxins and furans must be monitored in citrus pulp for poultry feeding (Ministry of Agriculture Normative Instructions 08/1999 and 9/2001). There is also the necessity of presenting a certificate showing the levels of dioxins in beef cattle, pork, chicken, eggs and milk (Brazilian Health Regulatory Agency Resolution 364/1999). The *codex alimentarius* is used for guidance.

Regarding the environment, the national program for vehicles air pollution control establishes limits which indirectly control PCDD/PCDF releases and also prohibit the use of lead in the gasoline (National Environment Council Resolution 18/1986 and 5/1989).

PCDD/PCDF releases from fixed emission sources are also controlled indirectly through other parameters, like particulate matter (National Environment Council Resolution 382/2006 and 436/2011).

Only one resolution, which regards waste thermal treatment, indicates threshold values for dioxin and furan emission and requires the Best Available Technique (National Environment Council Resolution 316/2002).

For wastewaters, it is forbidden to discharge POPs in water bodies (National Environment Council Resolution 430/2011).

The national policy for waste management also contributes only indirectly for PCDD/PCDF emissions control (Law 12.305/2010).

## **BRAZILIAN CHALLENGES AND PROBLEMS**

Brazil presents a huge limitation in monitoring dioxin and furans.

14 laboratories are able to sampling and analyzing dioxin and furans in Brazil. Only two of them are public and one of them doesn't operate commercially and the other only analyzes the pollutants in food matrices.

9 laboratories perform only the analysis, but 2 of them are not active. And only 2 perform both sampling and analysis.

The one with the greatest analytical capacity sends the samples to laboratories outside the country.

Sampling and analyzing costs are very high, what hinders the possibility of establishing a permanent monitoring of dioxin and furans by the industries.

Conservative thresholds for dioxin and furan releases must be defined, but the national condition must be considered.



## **OPPORTUNITIES AND WAYS FORWARD**

Brazil must present strategies for strengthening the analytical capacity of furans and dioxins. Once threshold values are established in law and the monitoring is required, laboratories will need to meet the demand and the analytical capacity tend to increase.

Protocols must be published by Brazilian authorities, focused on the industrial activities responsible for the major releases, for facilitating the monitoring, sampling and the analysis.

Best Available Techniques, especially regarding air emission treatment technologies, must be required through the legislation. Scrubber processes may present better efficiency levels if compared to the textile filters, usually employed by the main industrial activities.

Legislation must approach PCDD/PCDF releases control objectively and establish threshold values more conservative, but also more suitable to the national context.

Finally, other processes besides the industrial ones, may be studied and the Best Environmental Practices must be applied. For open burning, for example, legislation prohibiting sugarcane burning was an important tool employed in São Paulo state and should be expanded to the entire country.

## **EXPECTATIONS FROM THE TRAINING COURSE**

Thermal power plants represent an emerging source of releases in Brazil, once hydroelectric potential becomes smaller. The implementation of new thermal power plants already employing Best Available Techniques and Best Environmental Practices would prevent an increase in the Brazilian emission of dioxin and furans.

There is also a necessity of establishing thresholds, parameters and protocols for sampling, monitoring and controlling this source of emission and also the other industrial sources.

Thus, the course will allow Brazil to draw strategies for preventing new emissions and also improving the control performed in the current sources of emissions in the country.

Information acquired in the course must eventually be used for assisting the creation of laws regarding the theme and also for publishing protocols and handbooks for helping the sector industries to adjust to the legislation and to the Best Available Techniques and Best Environmental Practices.

## **REFERENCES**

MINISTÉRIO DO MEIO AMBIENTE. Inventário Nacional de Fontes e Estimativa de Emissões de Dioxinas e Furanos: Brasil POPs: Plano Nacional de Implementação Convenção de Estocolmo. Brasília: MMA, 2013. 188 p.

MINISTÉRIO DO MEIO AMBIENTE. Plano de Ação para a Redução Progressiva das Liberações de Poluentes Orgânicos Persistentes de Formação Não Intencional. Convenção de Estocolmo. Brasília: MMA, 2015. 136 p.