5 Master Plan on Industrial Waste Management

5.1 Future Socio-Economic Framework

5.1.1 Population

IBGE (Brazilian Institute of Geography and Statistics) conducted a long-term population projection between 1980 and 2050 and revised the projected results periodically. Here, the latest revised population projection of IBGE in 2004 is applied for projection of the population in the city of Manaus. According to the latest population data in IBGE, the population in Manaus is 1,738,641 in 2009. Based on this latest population data, the future growth of population in Manaus is projected as follows:

Table 5-1: Population Projection in Manaus (2009-2030)

Unit: thousand

Year	2009	2010	2015	2020	2025	2030
Population (Brazil)	194,370	196,834	208,468	219,078	228,874	237,738
Population (Manaus)	1,739	1,761	1,865	1,960	2,047	2,127

Source: IBGE (Brazilian Institute of Geography and Statistics)

The average annual population growth in the city of Manaus is estimated as 1.09% per year between 2009 and 2020 while it is 0.96% per year between 2009 and 2030.

5.1.2 Economy

According to the latest economic outlook available in the Central Bank of Brazil, the recent trend of GDP growth of Brazil and Manaus is as shown in the table below.

Table 5-2: Recent GDP growth in Brazil and Manaus

Year	2003	2004	2005	2006	2007	2008
Brazil GDP (billion Real)	2,376	2,512	2,591	2,694	2,858	3,005
Real Growth Rate (%)	1.1	5.7	3.2	4.0	6.1	5.1
Manaus GRDP (billion Real)	28.85	32.96	33.30	36.29	NA	NA
Real Growth Rate (%)	NA	14.2	1.0	9.0	NA	NA

Source: The Central Bank of Brazil

According to the announcement of the Finance Minister of Brazil, the real growth rate of GDP in Brazil is estimated as 1.22% in 2009 while it is expected to increase up to 5.8% in 2010. Based on the past trend of economic growth in Brazil, the study estimated the future economic growth with linear regressions model up until the year 2030. The result of estimation is shown in the next table.

Table 5-3: Estimated Economic Growth of Brazil

Year	2008	2010	2015	2020	2025	2030
Brazil GDP (billion Real)	3,005	3,218	3,794	4,386	4,978	5,570
Growth Rate (%/year)	-	3.5	3.3	2.9	2.6	2.3

Source: the Finance Minister of Brazil

On the other hand, the regional GDP of Manaus is only available between 2004 and 2006, by applying the linear regression model, the future economic growth of Manaus is estimated as shown in the table below.

Table 5-4: Estimated Economic Growth of Manaus

Year	2006	2010	2015	2020	2025	2030
Manaus GRDP (billion Real)	36.29	44.17	52.50	60.82	69.15	77.47
Growth Rate (%/year)	-	5.0	3.5	3.0	2.6	2.3

Source: the Finance Minister of Brazil

5.1.3 Estimation of the Future Industrial Growth

As for the source of data for the estimation of the future industrial growth, "Trend in Industrial Production Value by Type of Industry during 2004-2008, SUFRAMA" was used.

a. Source of Data Used

The following baseline data were calculated to estimate the framework of future industry growth of the Manaus Free Trade Zone.

1. Trend in Industrial Output by Type of Industry
2. Trend in Production Value by Type of Industry
3. Number of Employees by Type of Industry

The industrial output data (first item above) contains the trends of only a very limited set of products; with not enough data available to represent the entire SUFRAMA area, it was eliminated from the baseline data.

On the other hand, the production values (second item above) contain the industrial classifications for major sectors from 2004 to 2008, which is approximate to the classification used for the factory survey in this study and thus effective baseline data when used to establish the framework of future industry growth.

The third item above, concerning number of employees, contains detailed data beyond the sector-based employee data used in the factory survey. However, trends over time are not categorized by sector but only changes in the total number of employees in the SUFRAMA region.

Based on these factors, the study chose to apply the production value data by industrial sector in the SUFRAMA region, 2004 ~ 2008, to predict the framework of future industry growth.

b. Application of Production Value Data by Type of Industry

There is an inherent correlation between the industrial output in each sector and the amount of industrial waste generated. In turn, this underlines another correlation between industrial output and production value. However, to calculate production value using the unit generation amount (ton/real) requires taking into account trends in commodity prices and exchange rates. Therefore, estimating future industrial growth is done, first, by converting the current value, which is given in the data provided by SUFRAMA in Dollars, and obtaining the Brazilian currency value (Real) by using the yearly average exchange rate for each year. Then, discounting the inflation rate based on the 2004 consumer price index, and calculating the yearly production value for each type of industry. (Supporting Report: referencing the estimated value of production by type of industry, the 2004~2008 data is based on current data converted to 2004 real price value of production.)

c. Estimation of the Future Industrial Growth (2008-2030)

The framework of future industry growth is the basis of estimating the future industrial waste generation in PIM. The amount of industrial waste generation has the strongest correlation to industrial production although it is not linear considering the improvement of productivity in respective industries.

To estimate the future industrial growth in PIM, the study utilizes the data of industrial output by types of industry during 2004-2008 available in SUFRAMA, as shown in the table below.

Table 5-5: Trend of Industrial Production Value during 2004-2008

Unit: million $US

Factory Code	Sector	2004	2005	2006	2007	2008
F01	Beverage	152	163	210	84	100
F16	Garment & Footwear	5	12	17	12	21
F03	Printing	35	32	34	36	39
F04	Electrical/Electronics	4,967	6,748	7,840	8,029	8,993
F05	Lumber	21	23	21	25	23
F06	Machinery (Mechanical)	333	475	524	654	788
F07	Metals	393	678	1,068	1,505	2,090
F08	Non-Ferrous Metals	35	51	68	94	151
F09	Furniture	10	15	18	20	27
F10	Paper & Packaging	87	132	158	172	188
F11	Rubber	1.4	1.0	0.5	0.2	1.7
F12	Food Product	59	65	69	52	63
F13	Chemical	1,253	1,584	2,016	2,640	2,987
F14	Plastics	729	1,101	1,279	1,422	1,669
F15	Textiles	5	6	7	7	8
F17	Transportation Equipment	2,353	3,153	4,185	5,948	7,668
F19	Others	3,752	4,676	5,236	4,995	5,359
Total		14,190	18,915	22,750	25,695	30,176

Source: SUFRAMA

With the past industrial output data above, the future industrial growth in Manaus Free Zone is estimated in accordance with the following steps:

STEP 1: Conversion of the industrial output into real output value at 2004 price in Real

The industrial output value during 2004-2008 is converted into real output value at 2004 price in Brazilian Real using deflators and the average currency exchange rate in respective years, as shown in the table below.

Table 5-6: Trend of Industrial Output Value during 2004-2008 at 2004 Price

Unit: million Real

Factory Code	Sector	2004	2005	2006	2007	2008
F01	Beverage	445	370	429	160	178
F16	Garment & Footwear	15	27	35	22	38
F03	Printing	104	72	70	68	70
F04	Electrical/Electronics	14,536	15,270	15,988	15,213	15,974
F05	Lumber	62	53	44	47	41
F06	Machinery (Mechanical)	976	1,075	1,069	1,240	1,399
F07	Metals	1,150	1,535	2,177	2,851	3,712
F08	Non-Ferrous Metals	103	116	139	178	269
F09	Furniture	31	34	37	38	48
F10	Paper & Packaging	255	299	322	327	333
F11	Rubber	4.0	2.3	1.0	0.4	3.0
F12	Food Product	172	146	141	98	111
F13	Chemical	3,667	3,584	4,111	5,001	5,305
F14	Plastics	2,134	2,492	2,607	2,695	3,138
F15	Textiles	15	13	14	13	14
F17	Transportation Equipment	6,886	7,135	8,534	11,270	13,620
F19	Others	10,972	10,578	10,675	9,465	9,347
Total		41,527	42,801	46,393	48,686	53,600

Source: SUFRAMA

STEP 2: Estimation of the future industrial growth by approximate function analysis for each type of industries

Based on the approximate function analysis of the past trend of industrial growth for each type of industries, the study estimated the future industrial growth as shown in the table below up until the year 2030.

Table 5-7: Estimation of the Future Industrial Growth (2008-2030)

Unit: million Real

Factory Code	Sector	2008	2010	2015	2020	2025	2030
F01	Beverage	178	157	113	91	78	69
F16	Garment & Footwear	38	44	65	86	106	127
F03	Printing	70	59	52	48	45	43
F04	Electrical/Electronics	15,974	16,524	17,934	19,344	20,754	22,164
F05	Lumber	41	38	34	31	29	28
F06	Machinery (Mechanical)	1,399	1,556	2,062	2,568	3,074	3,580

F07	Metals	3,712	4,860	8,079	11,299	14,518	17,738
F08	Non-Ferrous Metals	269	318	515	712	908	1,105
F09	Furniture	48	53	72	92	111	131
F10	Paper & Packaging	333	381	473	565	658	750
F11	Rubber	3.0	0.8	0.5	0.4	0.3	0.3
F12	Food Product	111	96	81	73	67	63
F13	Chemical	5,305	6,211	8,558	10,905	13,251	15,598
F14	Plastics	3,138	3,325	4,257	5,190	6,123	7,055
F15	Textiles	14	13	11	10	8	6
F17	Transportation Equipment	13,620	16,531	25,334	34,136	42,939	51,742
F19	Others	9,347	8,636	6,625	4,612	2,603	590
Total		53,600	58,803	74,265	89,762	105,272	120,789

Source: SUFRAMA

The estimation above is based on a 'Business-as-Usual' scenario, assuming that past trends revealed by statistical analysis will be reflected in future industrial growth. If SUFRAMA has some plans on future industrial location and/or development of Manaus Free Zone, it should be reflected to improve this estimation.

5.2 Projection of Future IW Generation

5.2.1 Scope of Projection

a. Target Industry Types

In this report, the following 19 industry classifications used by SUFRAMA for PIM factories were used as the targets for the future estimate of IW generation[1]

Table 5-8: SUFRAMA's Factory Classification

Factory Code	Description of subsector
F01	Beverage (soft drink, alcoholic) and vinegars
F02	Leathers, skins and similar
F03	Printing and graphical company
F04	Electric, electronic and communication materials
	4.1 Components
	4.2 Products (except copy machines)
	4.3 Copy machines and similes
F05	Wood
F06	Mechanical
	6.1 Watch
	6.2 Other mechanical industries
F07	Metallurgy
F08	Non metallic minerals
F09	Furniture
F10	Paper, cardboard, cellulose

[1] Industries (companies) established and producing in western Amazon with full projects approved by SUFRAMA (CGPRI & CGMER/COCAD SUFRAMA , up to 8/2008)

F11	Rubber
F12	Food products
F13	Chemical
F14	Plastic material products
F15	Textile
F16	Clothing, fabric and travel goods
F17	Transport material
	17.1 Two wheel
	17.2 Naval
	17.3 Other transport material industry
F18	Construction
F19	Others
	19.1 Optical
	19.2 Toys
	19.3 Devices, equipment, and fotogr. accessories
	19.4 Pens and disposable razors
	19.5 Other several industries

b. Targeted Industrial Waste

The industrial wastes targeted for generation estimates are those required by CONAMA Resolution 313 to be included in a waste inventory. For this report, the following three main categories were used to estimate generation amount.

- General Industrial Waste
- Health-care Waste
- Construction Waste

c. Estimation Period for Generation Amount

The estimation period for the generation amount will be until the Master Plan target year 2015.

5.2.2 Methodology of Estimating Future IW Generation

a. Formula used to Estimate the Generation Amount

Estimation of future IW generation amount was made based on the following equation.

$$IWG = \sum_{i=1}^{n} \sum_{j=1}^{m} (Mi \cdot Gij)$$

Basically, the future IW generation amount is calculated using **the generation rate (G)** from each generation source, multiplied by **the number of basic units (M)** from each generation source. The number of basic units (M) can be the production amount, production value, etcetera, but in this study, number of employees was used for reasons given below.

The following table shows how each item of the above formula was established in terms of the previously mentioned 3 types of industrial waste.

Table 5-9: Explanation of Items of Estimation Formula for Future IW Generation Amount

Formula Items	General IW	Health-care Waste	Construction Waste
IWG	Generation Amount of General IW (ton/year)	Generation Amount of Health-care Waste (ton/year)	Generation Amount of Construction Waste (ton/year)
i	Factory type	Only one generation rate (GR) is used for all PIM factory	Only one generation rate (GR) is used for all PIM factory
j	Type of general IW	Type of health-care waste	Type of construction waste
M	Number of employees	Number of employees	Number of employees
G	Waste generation rate (ton/year/person)	Waste generation rate (ton/year/person)	Waste generation rate (ton/year/person)
n	Factory type number (19 types)	Factory type number (only one type)	Factory type number (only one type)
m	Waste type number (29 types)	Waste type number (5 types)	Waste type number (4 types)

b. Setting the Waste Generation Rate (GR)

The waste generation rate (GR) is given for each type of waste for all three types of industrial waste[1]. The GR used is ton per year per person (ton/year/person). The GR was established based on data that the study team gathered when carrying out three surveys: factories, medical institutions, and construction waste. Here, to estimate waste generation amount, it is assumed that until 2015 there is no change in the GR. The table below shows the industry type and generation amount of each type for general industrial waste.

b.1 General Industrial Waste

The tables below show the industry type and generation rate (GR) of each type for general industrial waste. However, Table 5-10 shows the Non-Hazardous and Hazardous industrial waste (Non-HIW and HIW, respectively) according to Non-Production and Production Process in each industry type, whereas Table 5-11 shows the waste generated from Non-Production and Production Process according to Non-HIW and HIW in each industry type. Namely, this is a selection of the generation rates found in the study; the GR of 29 waste types were calculated for each of the 19 types of industry, but the detailed results are given in the Data Book.

Table 5-10: Generation Rate for General Industrial Waste by Industry Type

Unit : kg/person/year

Factory Code	Non-Production Process		Production Process	
	Non-HIW	HIW	Non-HIW	HIW
F01	1,349.6	19.0	111.8	21.1
F02[*1]	---	---	---	---
F03	84.2	6.4	1,686.2	899.1
F04		86.7	910.8	195.5
F05[*2]				

[1] Given for 19 factory types for general IW.

F06	557.2	228.3	1,699.5	242.9
F07	745.0	141.3	2,979.8	207.5
F08	184.1	1.7	841.4	3.1
F09			72.1	245.2
F10	11,481.4	69.9	5,006.7	448.2
F11*2				
F12	0.4		14,125.3	241.1
F13	133.1	0.9	1,089.2	100.0
F14	291.1	781.3	465.0	71.5
F15*2				
F16*2				
F17	137.3	13.8	471.4	363.6
F18*2				
F19	250.7	0.8	692.3	218.6
All Category	439.4	112.0	885.8	262.4

Note : *1 : No factory corresponded to category F02 on the SUFRAMA factory list.
*2 : Listed on the SURAMA factory list and requested for the factory survey, but none of factory of this category was surveyed in this study.

Table 5-11: Generation Rate of General Industrial Waste by Waste Type

Unit : kg/person/year

Waste Code	Non- HIW		Waste Category	HIW	
	Non Process	Process		Non Process	Process
NH01	66.9	1.5	HW01	0.0	0.8
NH02	45.9	42.9	HW02	---*1	---*1
NH03	89.6	241.3	HW03	0.0	0.1
NH04	22.0	136.7	HW04	0.0	9.1
NH05	3.0	0.4	HW05	0.0	0.6
NH06	0.3	0.0	HW06	---*1	---*1
NH07	0.0	0.5	HW07	0.7	56.4
NH08	---*1	1.9	HW08	---*1	3.0
NH09	82.7	360.2	HW09	33.2	30.2
NH10	24.7	16.5	HW10	0.0	0.0
NH11	1.7	4.9	HW11	51.9	8.4
NH12	4.6	0.1	HW12	---*1	0.8
NH13	98.0	78.9	HW13	2.7	0.4
All Category	439.4	885.8	HW14	1.8	115.2
			HW15	14.5	26.5
			HW16	7.2	10.9
			All Category	112.0	262.4

Note : *1: Indicates that corresponding waste was not generated.

b.2 Health-care Waste

The generation amount of each group of health-care waste is given in the table below.

Table 5-12: Generation Rate of Health-care Waste

Waste Category			Clinics		General Hospital
			kg/clinic/day	g/employee/day[*1]	kg/hospital/day
Group A	A1	Biologic	0.16	0.22	6.01
	A2	Animals	0.00	0.00	0.00
	A3	Body part	0.10	0.14	8.11
	A4	Patient care etc.	0.26	0.36	8.64
	A5	Prions	---	---	---
Group B		Chemical etc.	0.27	0.38	1.7
Group C		Radioactive waste	0.00	0.00	0.0
Group E		Piercing or Cutting	0.44	0.62	3.4
Group D		Common waste	1.17	1.64	94.0
Total			2.40	3.36	121.8

Note *1: In 2009, there were 116,192 employees.

b.3 Construction Waste

The generation rate was calculated for each class of construction waste, as listed in CONAMA Resolution 307.

Table 5-13: Generation Rate of CONAMA Resolution 307 Construction Wastes

Class	Class A	Class B	Class C	Class D	Total
Generation unit (kg/factory/day)	227.14	1.04	0.00	0.00	228.18

In the survey, the 4 classes of waste as shown in CONAMA Resolution 307 were subdivided into 44 types. The generation rates for those 44 types which were reported are given below. For those waste codes not listed indicates that generation of such waste was not reported.

Table 5-14: Generation Rate of Construction Waste

Waste No.	Name of Waste	kg/factory/day
01	Excavated soil	9.04
02	Concrete debris	14.75
03	Asphalt debris	17.12
04	Brick debris	0.83
06	Tile and ceramic	0.003
11	Plastic/vinyl sheet	0.12
12	Iron-bar, steel materials	0.07
13	Small metal waste	0.16
17	Plaster boards	0.01
20	Wood debris	0.37
21	Timber form	0.06

22	Scaffolding material	0.34
23	Interior timber	0.32
24	Packing (cardboard)	0.26
29	Machine oil	0.02
33	Ash	0.05
44	Mixed construction waste	184.66
Total		228.18

c. Future estimation for number of employees

The future estimation of number of employees is an important variable when estimating the waste generation amount. The variable for number of employees was selected, particularly, for the following reasons.

1. It is estimated that "the increase in waste generated from factories tends to be closer in relation to growth in number of workers rather than growth in production."
2. Manufacturers and other industries will increase production according to a rise in demand to expand their profits, but they attempt to control production costs per item as much as possible through improved productivity. These efforts include improving worker productivity, economizing energy use and resources (raw materials).
3. Economizing on energy and resources is, in due course, tied to the reduction of waste generated through production activities. Therefore, assuming such efforts are made, the future amount of waste generated is estimated as a factor in improved productivity included in "growth in number of employees" rather than output growth.

However, the only data available is that for the total number of employees in PIM overall, as the corresponding data for the categories in each of the 19 types of industry does not exist. Accordingly, analysis of the correlation between total number of employees in PIM, 2004 ~ 2008, and estimated industrial growth resulted in an average annual growth in overall PIM production value of 6.6%, thus confirming that average annual growth of direct employment in the same period will remain at 5%.

Based on these results, the forecast for employees in each type of industry was estimated using the following method.

1. The correlation between the change in number of employees in PIM (annual average of 5.0% growth, 2004 ～2008) and change in production value (annual average of 6.6% growth, 2004 ～2008) was estimated, showing that PIM labor productivity will improve 1.5% annually on average.
2. Based on the assumption above, using the 2009 data for number of employees in each of the 19 industry types, and 2009 ~ 2015 estimated industry growth for each industry type, the number of employees in each sector was estimated for 2015 using the following formula:

   Number of Employees (2015) = Number of Employees (2009)× {2015 industrial growth/(2009 industrial growth×1.015^6)}
3. Results were similarly sought for each of the 19 types of industry.

The forecast for number of employees was estimated using the above conditions with the results as shown in the following table.

Table 5-15: Estimated Forecast for Number of Employees

Factory Code	2009			2015		
	Industrial growth	Number of Employee	Unit Industrial growth	Industrial growth	Number of Employee	Unit Industrial growth
	(mil. Real)	(employee)	(mil. Real /employee)	(mil. Real)	(employee)	(mil. Real/employee)
F01	173	2,975	0.058	113	1,794	0.063
F02	---	---	---	---	---	---
F03	62	843	0.074	52	642	0.081
F04	16,242	37,765	0.430	17,934	38,157	0.470
F05	40	348	0.115	34	270	0.126
F06	1,455	5,464	0.266	2,062	7,086	0.291
F07	4,217	6,003	0.702	8,080	10,521	0.768
F08	279	698	0.400	515	1,178	0.437
F09	49	445	0.110	72	600	0.120
F10	363	1,789	0.203	473	2,131	0.222
F11	0.9	133	0.007	0.5	63	0.008
F12	101	538	0.188	81	393	0.206
F13	5,742	1,355	4.238	8,558	1,847	4.634
F14	3,138	9,625	0.326	4,257	11,958	0.356
F15	13	20	0.650	11	15	0.711
F16	40	589	0.068	65	878	0.074
F17	14,771	43,937	0.336	25,334	69,030	0.367
F18	9,355*1	440	21.261	6,623*1	285	23.248
F19		3,225	2.901		2,088	3.172
Total	56,041	116,192	0.482	74,265	148,936	0.527

*1: Statistically, the type of industrial growth for F18 and F19 are the same. Here, in order to calculate the unit industrial growth for each industry, the same industrial growth trends were used.

The value and rate of both total industrial growth and total number of employees were estimated, as shown in the following graph.

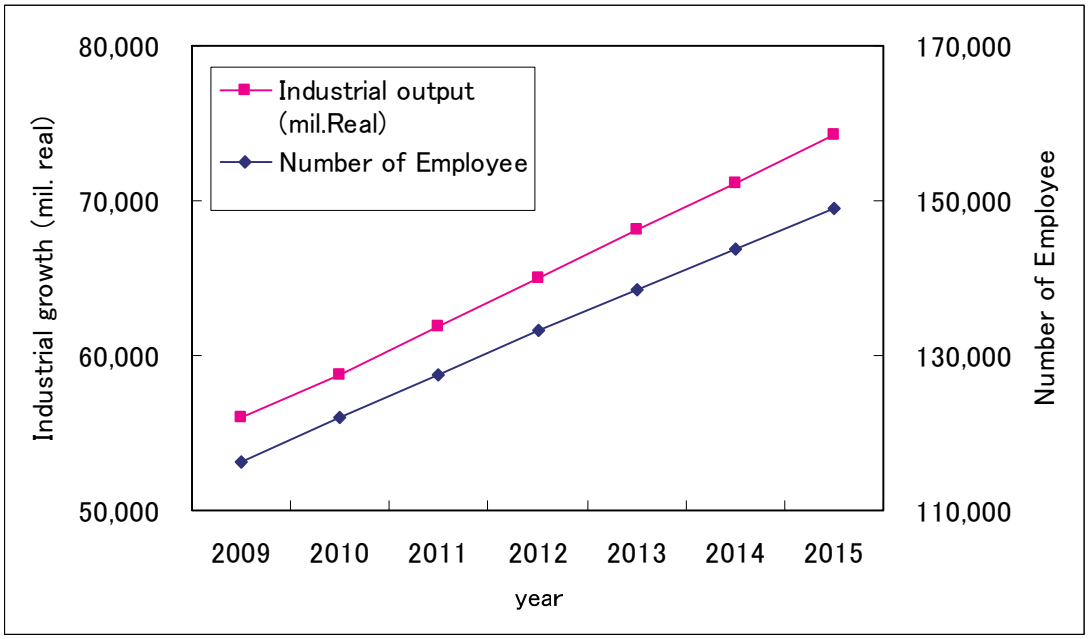


Figure 5-1: Estimated Results for Total Industrial Growth and Total Number of Employees (Forecast)

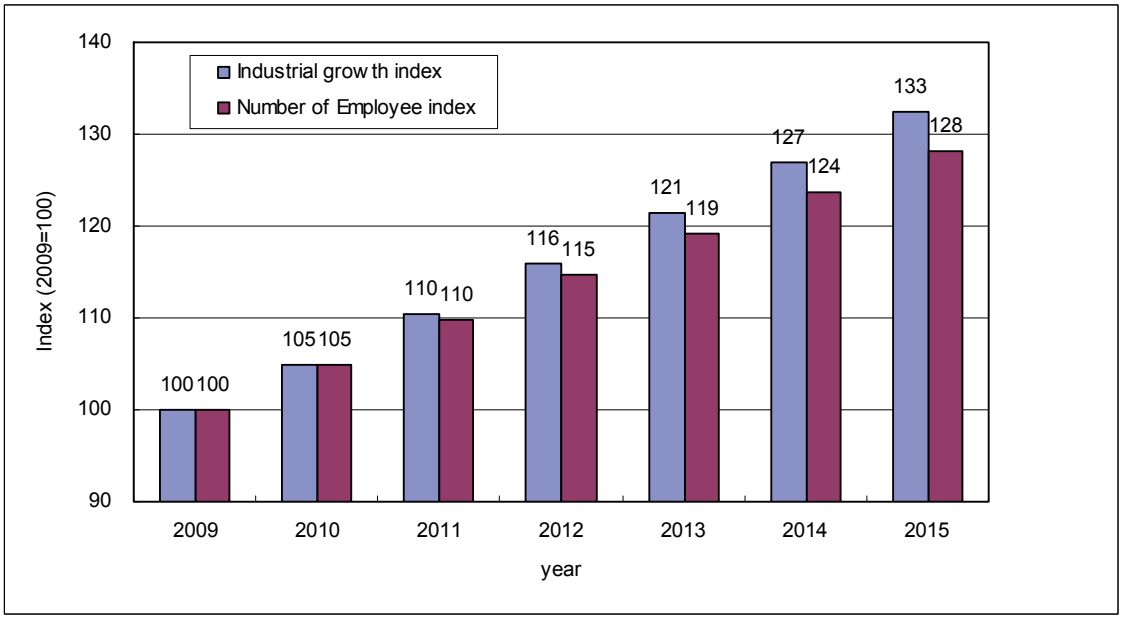


Figure 5-2: Estimated Results for Total Industrial Growth and Total Number of Employees (Rate)

5.2.3 Estimation of Future IW Generation Amount

Future IW generation rate is the product of the above-mentioned generation rate of industry/industrial waste by type (general IW, health-care waste, construction waste) and the number of employees by industry. The results are as follows.

a. General Industrial Waste Generation

The generation amount of general industrial waste in the entire target area of the study may be calculated by multiplying a GR of a general IW by the number of employees of each year. Below, Non-HIW and HIW generated from Non-Production and Production Processes was calculated for 2015.

The generation amount of general IW in 2009 was estimated at 591.5 ton/day. Further, the 2015 general industrial waste amount generated was estimated by multiplying each type of waste in each sector (Factory Category) by the future index 737.7 ton/day. It is estimated that in 2015 there will be about 1.3 times the present amount of general IW.

Table 5-16: Forecast Generation Amount of General IW by Factory Category (2015)

Factory Category		Non-Production		Production Process		All Process	
		Non-HIW	HIW	Non-HIW	HIW	2009	2015
F01	Beverages	6.6	0.1	0.5	0.1	12.2	7.3
F02	Leather	-	-	-	-	-	-
F03	Printing	0.1	-	3.0	1.6	6.2	4.7
F04	Electrical	51.3	9.1	95.2	20.4	174.1	176.0
F05	Lumber	0.3	0.1	0.7	0.2	1.7	1.3
F06	Machinery	10.8	4.4	33.0	4.7	40.9	52.9
F07	Metal	21.5	4.1	85.9	6.0	67.0	117.5
F08	Nonferrous Metal	0.6	-	2.7	-	2.0	3.3
F09	Furniture	0.7	0.2	0.1	0.4	1.0	1.4
F10	Paper	67.1	0.4	29.2	2.7	83.3	99.4
F11	Rubber	0.1	-	0.2	-	0.6	0.3
F12	Food	-	0.1	15.2	0.3	21.3	15.6
F13	Chemical	0.7	-	5.5	0.5	4.9	6.7
F14	Plastic	9.5	25.6	15.2	2.3	42.4	52.6
F15	Textiles	-	-	-	-	0.1	0.1
F16	Clothing	1.1	0.3	2.1	0.6	2.7	4.1
F17	Transportation	26.0	2.6	89.2	68.8	118.8	186.5
F18	Construction	0.3	0.1	0.7	0.2	2.1	1.3
F19	Other	1.4	-	4.0	1.3	10.2	6.7
Total		198.1	47.1	382.4	110.1	591.5	737.7

As shown in the table above, 93% of the total general IW will be generated in the following 6 factory's categories:

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
F04	Electrical industry	174.1	176.0	1.1
F17	Transport Machinery	118.8	186.6	57.0
F10	Paper industry	83.3	99.4	19.3
F07	Metal industry	67.0	117.5	75.3
F14	Plastic Industry	42.4	52.6	24.1
F06	Machinery	40.9	52.9	29.3
Total		526.5	685.0	30.1

Among the 6 large generation sources the highest increase rate is F07: Metal Industry, 75.3%, followed by F17: Transport Machinery, 57.0%.

The following two tables show forecast of generation amount of general Non-HIW and HIW in 2015, respectively:

Table 5-17: Forecast Generation Amount of General Non-HIW by Type of Waste (2015)

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount	
		2009	2015
NH01	Kitchen waste (include waste from animal such as bone, skin, hair)	26.0	32.8
NH02	Wood	29.2	34.0
NH03	Paper	120.0	137.2
NH04	Plastic or polymers and resins	54.5	62.8
NH05	Textile and fiber	1.0	1.1
NH06	Animal oil, Vegetable oil	0.1	0.1
NH07	Rubbers and Leather	0.2	0.2
NH08	Ash/dust from coal-fired power plants, etc.	0.7	0.7
NH09	Metals and metal alloys such as aluminum, copper, bronze	163.6	218.0
NH10	Ceramic & Glasses	13.4	14.8
NH11	Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	1.7	2.6
NH12	Mixed waste (This code shall be applied in case wastes are discharged without separation.)	1.5	1.1
NH13	Others	59.9	75.1
Total		**471.8**	**580.5**

Table 5-18: Forecast Generation Amount of General HIW by Type of Waste (2015)

Unit: ton/day

Waste Code	Description of Non-HIW	Generation Amount	
		2009	2015
HW01	Inorganic acid	0.2	0.3
HW02	Organic acid	-	-
HW03	Alkalis	-	-
HW04	Toxic Compounds	2.8	3.6
HW05	Inorganic Compounds	0.2	0.3
HW06	Other Inorganic	-	-
HW07	Organic Compounds	18.9	22.5
HW08	Polymeric Materials	1.0	1.4
HW09	Fuel, Oil and Grease	20.0	27.0
HW10	Fine Chemicals and Biocides	-	-
HW11	Treatment Sludge	20.6	24.9
HW12	Ash from incinerator	0.2	0.3
HW13	Dust and Air pollution control (APC) products	1.0	1.8
HW14	Other Hazardous substance (besides HW01-HW13)	34.4	50.7
HW15	Mixed Waste	14.7	16.9
HW16	Hazardous materials from Non-production process	5.7	7.5
Total		**119.7**	**157.2**

As shown in the Table 5-17, 72% of the general Non-HIW will be main 3 types of waste, i.e. NH09: Metal Scrap, NH03: Waste Papers and NH04: Waste Plastics. Among the 3 main types of general Non-HIW the highest increase rate is NH09: Metal Scrap, 33.3%, followed by NH04: Waste Plastics, 15.2%.

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
NH09	Metal Scrap	163.6	218.0	33.3
NH03	Waste Papers	120.0	137.2	14.3
NH04	Waste Plastics	54.5	62.8	15.2
-	Other than the above 3 Types of Waste	133.7	162.5	21.5
	Total	471.8	580.5	23.1

As shown in the Table 5-18, 47.3% of the general HIW will be main 3 types of waste, i.e. HW09: Fuel, Oil and Grease, HW11: Treatment Sludge and HW07: Organic Compounds. Among the 3 main types of general HIW the highest increase rate is HW09: Fuel, Oil and Grease, 353%, followed by HW11: Treatment Sludge, 20.9%.

Factory Code	Type of Industry	Waste Generation in 2009 (ton/day)	Waste Generation in 2015 (ton/day)	Increase Rate (%)
HW09	Fuel, Oil and Grease	20.0	27.0	35.0
HW11	Treatment Sludge	20.6	24.9	20.9
HW07	Organic Compounds	18.9	22.5	19.0
-	Other than the above 3 Types of Waste	60.2	82.8	37.5
	Total	119.7	157.2	31.3

b. Health-care Waste

The generation amount of health-care waste in the entire target study area is calculated by multiplying the generation rate per employee by the number of employees in each year. The results for each type of waste are shown below.

The generation amount of health-care waste in 2009 and 2015 is estimated at 391.2 kg/day and 500.5 kg/day, respectively. Health-care waste in 2015 will be generated at 1.3 times the current amount.

Table 5-19: Forecast Amount of Health-care Waste

Waste Category		Generation Rate	Generation amount	
		g/employee/day	2009	2015
			kg/day	kg/day
Group A	A.1	0.22	26.1	32.8
	A.2	0.00	0.0	0.0
	A.3	0.14	16.3	20.9
	A.4	0.36	42.4	53.6

	A.5	---	---	0.0
Group B		0.38	44.0	56.6
Group C		0.00	0.0	0.0
Group E		0.62	71.7	92.3
Group D		1.64	190.7	244.3
Total		3.36	391.2	500.5

c. Construction Waste

The amount of construction waste generated according to each class as shown in CONAMA Resolution 307 is calculated by multiplying the generation rate per employee for each waste by the number of employees each year. The results estimated for each type of waste are shown below.

The amount of construction waste generated in 2009 and 2015 is estimated at 36.96 ton/day and 47.54 ton/day, respectively. The amount of construction waste generated in 2015 is estimated to be about 1.3 times the current amount.

Table 5-20: Generation Amount of Construction Waste according to CONAMA Resolution 307

Class	Class A	Class B	Class C	Class D	Total
Construction Waste Generation in 2009	36.79	0.17	0.00	0.00	36.96
Construction Waste Generation in 2015	47.28	0.26	0.00	0.00	47.54

The study surveyed 44 types of waste according to the 4 classes as shown in CONAMA Resolution 307. The generation rate of these 44 types of wastes is shown below. For those waste codes not listed indicates that generation of such waste was not reported.

Table 5-21: Forecast Amount of Construction Waste

Waste No.	Name of Waste	Generation Rate	Generation amount	
			2009	2015
		kg/employee/day	ton/day	ton/day
01	Excavated soil	0.013	1.46	1.94
02	Concrete debris	0.021	2.39	3.13
03	Asphalt debris	0.024	2.77	3.57
04	Brick debris	0.001	0.13	0.15
06	Tile and ceramic	0.000	0.00	0.00
11	Plastic/vinyl sheet	0.000	0.02	0.02
12	Iron-bar, steel materials	0.000	0.01	0.01
13	Small metal waste	0.000	0.03	0.03
17	Plaster boards	0.000	0.00	0.00
20	Wood debris	0.001	0.06	0.16

21	Timber form	0.000	0.01	0.01
22	Scaffolding material	0.001	0.06	0.15
23	Interior timber	0.000	0.05	0.04
24	Packing (cardboard)	0.000	0.04	0.04
29	Machine oil	0.000	0.00	0.00
33	Ash	0.000	0.01	0.01
44	Mixed construction waste	0.257	29.92	38.28
Total		0.318	36.96	47.54

d. Total Amount of Industrial Waste Generated and IWM Stream in 2015

The following table shows the industrial waste generation amount for 2009 and 2015.

Table 5-22: The Industrial Waste Generation Amount for 2009 and 2015

unit : ton/day

Waste		2009	2015
GIW		591.5	737.7
	Non-GHIW	471.8	580.5
	GHIW	119.7	157.2
Health-care waste		0.4	0.5
Construction waste		37.0	47.5
Total		628.9	785.7

From the above results, it is estimated that the total generation amount for industrial waste in PIM in 2015 will be 785.7 ton/day.

If current IWM is continued in 2015, IWM flowchart will be shown in the following figure.

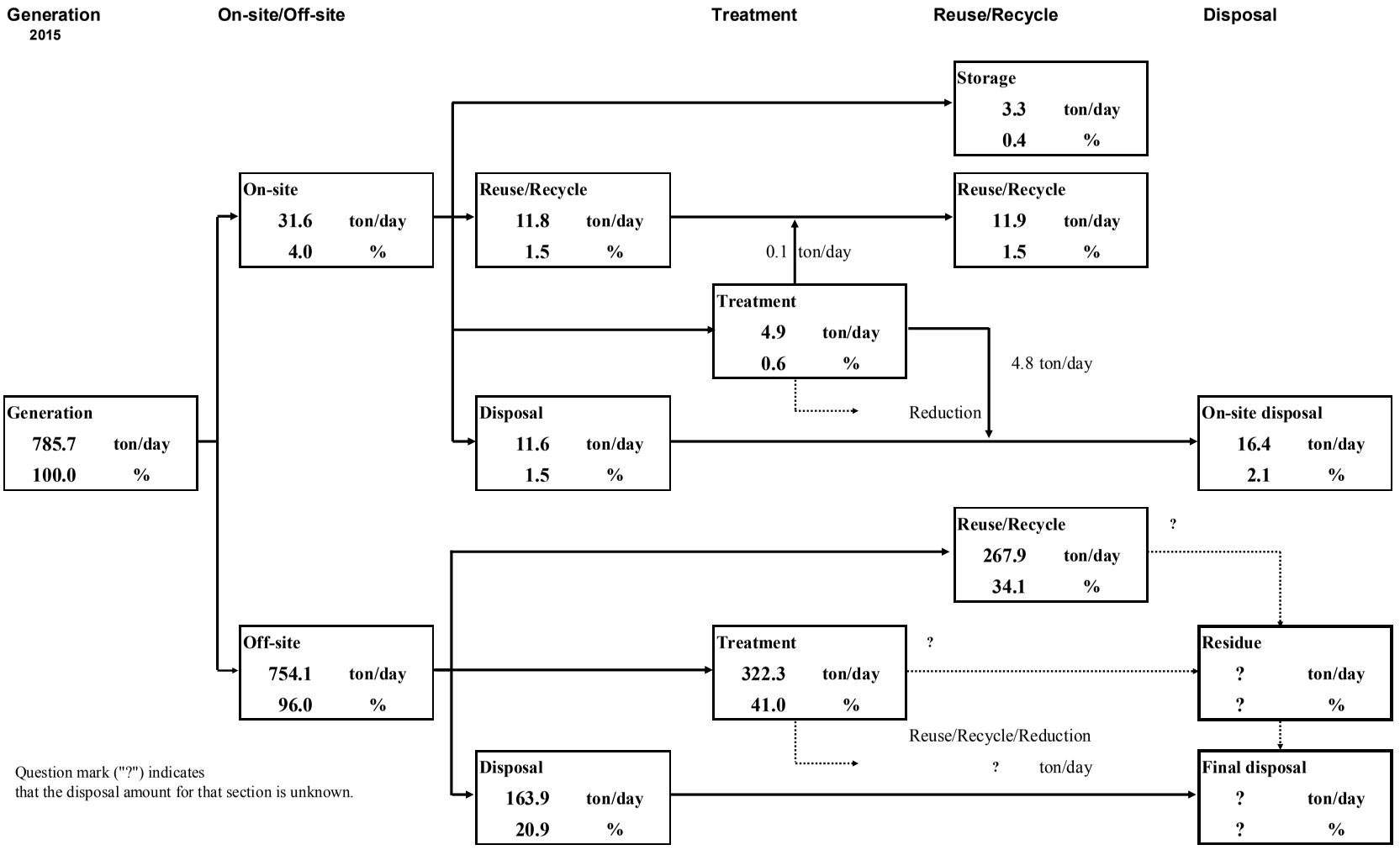


Figure 5-3: Industrial Waste Treatment and Disposal Stream in 2015

5.3 Background, Vision and Targets of M/P

5.3.1 Background of M/P

According to "Economic Instruments for the Amazon Protection, The Experience of Industrial Pole of Manaus", economic activity in PIM is a great contributor to the preservation of rainforest in the Amazonas State. As the table below shows, the rate of reduction in preserved forest area in Amazonas State from 2000-2005 was the lowest amongst all in the Amazon region. Further, the area of forest preserve in ratio to that of the entire state is second highest after the State of Amapá.

Table 5-23: Area of Forest Preserve in the Amazon Region

State	2000	2001	2002	2003	2004	2005	Reduction Rate
Amapá	98.8%	98.6%	98.5%	98.2%	98.1%	98.0%	0.8%
Amazonas	98.3%	98.2%	98.1%	98.0%	97.9%	97.9%	0.4%
Roraima	96.7%	96.1%	95.9%	95.6%	95.3%	95.2%	1.5%
Acre	90.3%	90.0%	89.4%	88.8%	88.2%	87.6%	2.7%
Pará	86.8%	84.6%	83.9%	82.9%	82.0%	81.3%	5.5%
Rondônia	70.6%	69.4%	68.0%	66.4%	64.1%	62.4%	8.2%
Mato Grosso	72.5%	71.2%	69.3%	67.3%	64.9%	63.3%	9.2%
Maranhão	54.9%	33.2%	32.1%	31.1%	29.8%	28.9%	26.0%
Tocantins	26.8%	26.1%	25.5%	25.1%	24.5%	23.5%	3.3%

(Source) Economic Instruments for the Amazon Protection, The Experience of Industrial Pole of Manaus

The same report also estimates that the amount of carbon credits in the seven years between 2000 and 2006 would be valued between 1 to 10 billion dollars.

As stated above, the measures by SUFRAMA to promote PIM have contributed greatly to forest preservation. Yet, the development of PIM has raised concern over environmental degradation due to illegal dumping of industrial waste, etc. The graph below illustrates the situation.

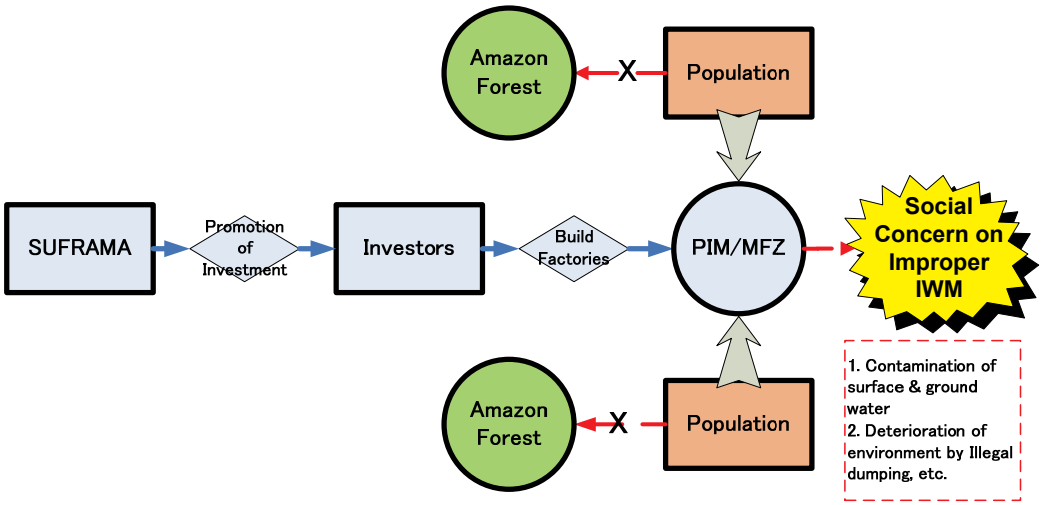


Figure 5-4: Relationship between PIM and Amazon Forest Preservation (Before M/P)

As the PIM developed, the Public Ministry of Amazonas State recognized the existence of environmental deterioration from illegal dumping of industrial wastes, etc. and, on December 21, 2001, called for SUFRAMA to obtain an environmental license for PIM. This caused SUFRAMA and IPAAM to join efforts in creating an environmental conservation plan for PIM, including proper management of industrial wastes, needed to obtain such a license.

SUFRAMA, as the counterpart of this study, will play the central roll in implementing the proposed M/P. As an organization, SUFRAMA is responsible for granting investment incentives with the aim of realizing socio-economic development by promoting commercial investment, starting with factories, agro-business and others, while also pursuing sustainable management practices to preserve the biodiversity widely found in the Occidental Amazon region.

Therefore, in addition to manufacturers, the M/P proposed in this study seeks to attract waste service companies that will play a role in environmental preservation and promote proper treatment of waste. The M/P was formulated keeping in mind the concept of further growth of PIM while continuing to promote the preservation of the State's natural environment. This principle is illustrated in the following figure.

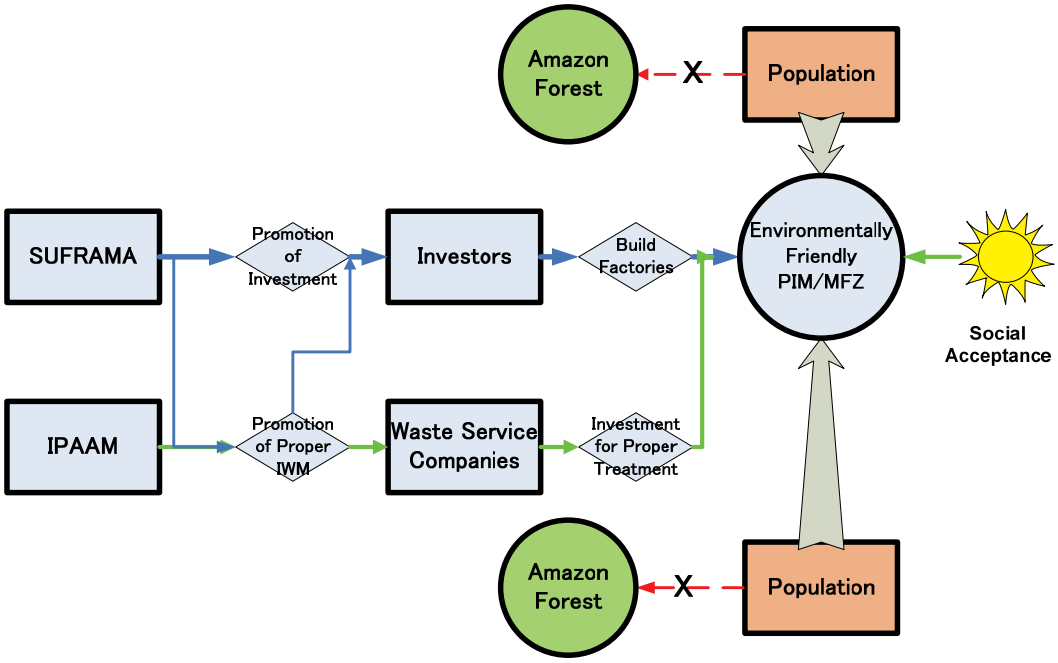


Figure 5-5: Relationship between PIM and Preservation of the Amazon Forest (After M/P)

5.3.2 Goal

The objective of the Master Plan (M/P) to be formulated in the study is to "Establish an appropriate industrial waste management system" by the target year 2015 for the study area, the Industrial Pole of Manaus (PIM).

Achieving this objective aims to meet the following overall objectives.

- That appropriate treatment and disposal of industrial waste and 3Rs (Reduce, Reuse, Recycle) will be implemented based on the industrial waste management master plan in the study target area.
- Through the appropriate treatment and disposal of industrial waste and implementation of the 3Rs, improper treatment and disposal of industrial waste will decrease and environmental impact will be reduced.

To realize the above conditions, companies both domestic and foreign will be encouraged to enter PIM and create new employment opportunities.

5.3.3 Issues to Overcome in order to Achieve Objectives

In order to achieve the M/P objectives, it will be necessary to solve the following issues related to the present system of industrial waste management.

a. Clarification of Industrial Waste Treatment and Disposal Practices

- Further information is needed from dischargers (factories) as well as waste service companies (WSCs) on the destination of residues after intermediate treatment, reuse and recycling. Without such information, it is not possible to clarify all aspects of industrial waste management in PIM (from generation to final disposal).
- The cause, despite the fact that IPAAM requires a waste manifest to be submitted in order to obtain an environmental license, is often a need for clear rules on the documents. Since the dischargers and the waste service companies each use and submit their own in-house forms, it is impossible for IPAAM to aggregate, analyze and manage the information contained in the manifests.
- Every PIM factory in the State of Amazonas must submit a waste inventory (WI). However, nearly 3/4 of factories do not submit WI.

b. Lack of a Landfill with Operation License

- The main final destination for industrial waste generated in PIM is, as of the end of 2009, two landfills; one owned by the municipality of Manaus and the other by a private company. However, neither is in possession of an operation license for the landfill. Since the landfills are the primary final destination for industrial waste generated in PIM, most factories in PIM are unable to satisfy the requirements to obtain ISO 14000.
- The construction and operation of a landfill which has obtained an operation license has been a long-time issue for PIM industrial waste management, but little progress has been made.
- In regards to final destination, co-processing treatments that do not produce a residue are extremely limited.[1]

[1] The sole cement factory, Itautinga, in the Manaus Free Zone treats 5,274 tons of waste per year (ref: WSC Survey). Using the factory's 2005 production output of 627,000 ton/year (Cement Factory Annual Report 2005: Sindicato Nacional da Industria do Cimento 2005), waste treatment (use of waste for cement production) is a mere 0.84% of production. In contrast, the percentage of waste treatment to cement production in Japan is 43.5%.

c. Weak Administration for the Industrial Waste Management System

- More staff is needed for industrial waste management since, as of December 2009, there are no staff at SUFRAMA dedicated to this work[1], and although there are 8 staff at IPAAM, they are responsible not only for industrial waste management but also for environmental licensing management.
- The waste service companies (WSC) registration management system is considered the environmental license system, which needs to be more fully developed.
- Administration is unable to expose non-registered or illegitimate companies so needs a clearer picture of actual conditions related to waste service companies.
- Waste inventories (WI) are submitted, but there is a need to strengthen abilities to analyze and manage them.

d. Poor Business Environment for Industrial Waste Treatment and Disposal

The business environment is very poor to conduct proper industrial waste treatment/disposal due to the following conditions:

- The landfill in Manaus City is used to dispose of a large amount of industrial waste but the disposal fee is currently "free".
- Many WSC which have not obtained an environmental license (non-registered) are disposing waste at extremely low cost.
- The administration is extremely limited in its regulation of non-registered companies and improper treatment and disposal.
- Conditions are such that competition between WSC is fierce and the disposal costs are extremely low. Thus, there are tremendous limits on investment for constructing and operating a proper treatment and disposal facility.

5.4 Master Plan

An industrial waste management master plan (M/P) has been put together to address how the industrial waste management issues presented in this chapter should be ameliorated.

5.4.1 Summary of Industrial Waste Management Master Plan

An approach and measures to resolve the above-mentioned 4 issues concerning industrial waste management are summarized in the figure below. Each approach and measure in the figure is then summarized in the table thereafter.

[1] As of December 2009, the industrial waste management unit has not been officially launched. There are plans to dispatch 3 staff to establish the unit in 2010.

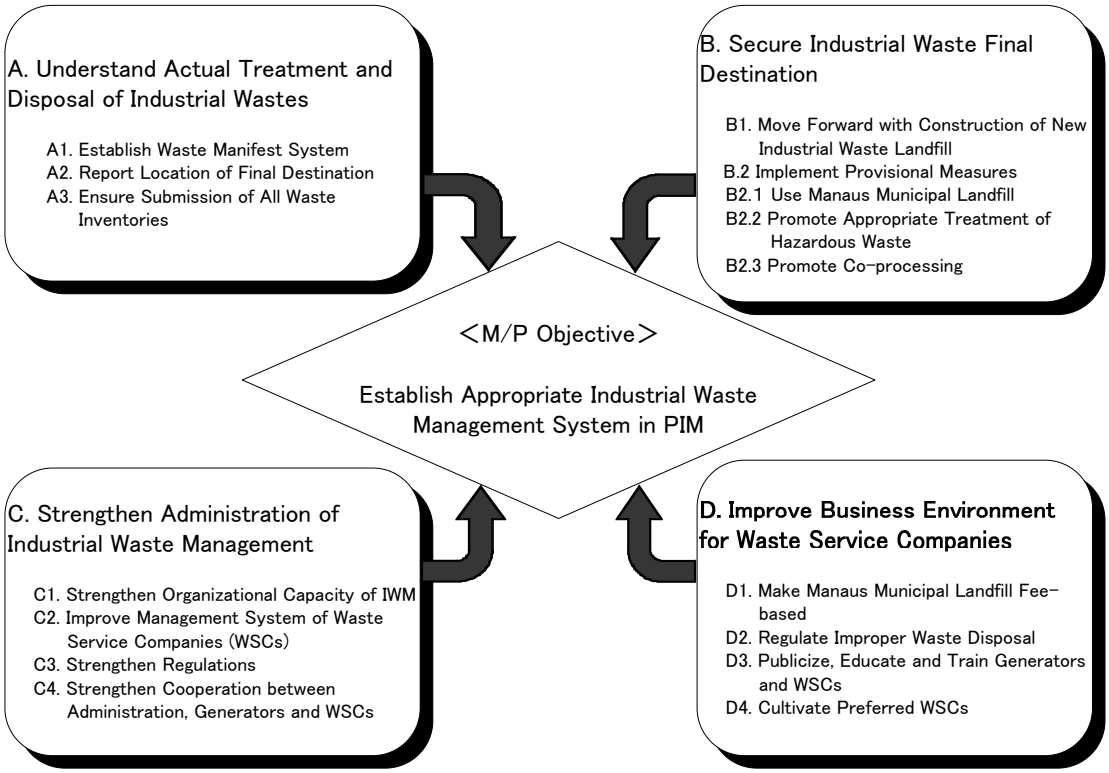


Figure 5-6: Summary of Master Plan Approach and Measure

Table 5-24: Summary of Master Plan

Approach & Measures	Objective	Content
Approach A. Understand Actual Treatment and Disposal of Industrial Waste • CONAMA Resolution 313 looks toward IPAAM to clarify the full spectrum of treatment /disposal of industrial wastes in the state of Amazonas and formulate an improvement plan. However, this has not yet been executed. • Understanding the full spectrum of treatment and disposal of waste generated from PIM is necessary /required for SUFRAMA to obtain an environmental license for DIs (Industrial Districts) as requested by the Public Ministry (PM) of Amazonas State.		
Measure 1. Establish Waste Manifest System	• IPAAM understands waste management conditions from factory discharge to final destination and manages it.	• IPAAM establishes a set format for a waste manifest in Amazonas State, collaborating with the INEA (State Institute of Environment) of Rio de Janeiro and others. • At the same time, work toward putting the waste manifest on-line.
Measure 2. Report Location of Final Destination	• Until the manifest system is established, IPAAM will understand and manage the final destination of factory waste.	• IPAAM requires generators (factories) to specify the final destination of industrial wastes on the application for operational license. • IPAAM requires all waste service companies to specify the final destination of wastes they are contracted to handle.
Measure 3. Ensure	• SUFRAMA raises the number of waste	• SUFRAMA constructs a system to manage waste inventories (WI).

Submission of All Waste Inventories	inventories submitted from 1/4th to 100%.	• Develop a waste inventory database (WI_DB). • Standardize WI reporting form in order to standardize input into WI_DB, and prepare guidelines. • Instruct factories to appoint a waste management officer that will prepare the waste inventory and submit to SUFRAMA. • Hold explanatory meetings for how to fill out waste inventories to ensure waste management officers at all factories understand the reporting forms. • Furthermore, arrange on-line preparation of WI and distribute the same input format to each factory.
Approach B. Secure Industrial Waste Final Destination • There are two landfills used as Final Destination for industrial waste generated in PIM, however neither has the proper operation license. Deciding how to secure Final Destinations is a major issue for PIM industrial waste management.		
Measure 1. Move Forward with Construction of New IW Landfill	• Construct a new industrial waste disposal site as the primary final destination for industrial waste generated in PIM as soon as possible.	• Create a system where waste generators bear the necessary disposal fee for the proper disposal of industrial waste. • Create an environment that promotes proper treatment and disposal by implementing a policy to eliminate improper disposal and prevent illegal dumping. • In addition to beneficial policies in the tax system, consider subsidies or other funding schemes for the construction of the landfill. • When planning the new industrial waste disposal site, make sufficient social and environmental considerations.
Measure 2. • Implement Provisional Measures until New Landfill is Operational		
Measure 2.1. Use of Manaus Municipal Landfill	• Use Manaus Municipal landfill as Final Destination until the new landfill is operational.	• Construct a dedicated site for Non-HIW & Non-inert industrial waste at one section of the Manaus Municipal landfill (ATRINI: Non-HIW & Non-inert Temporary Disposal Site). • Generators will pay a disposal fee for Non-HIW & Non-inert IW, which will be used to cover costs for construction and sustainable operation and management of ATRINI. • To promote the construction of ATRINI, SUFRAMA will work with the State Public Ministry (PM) to form a TAC (Terms of Agreement of Procedure) with Manaus City, IPAAM and other stakeholders.

		• After the Non-HIW & Non-inert Temporary Disposal Site (ATRINI) is constructed, Manaus City will only dispose of IW at ATRINI, which is strictly separate from the disposal site for municipal waste.
Measure 2.2. Promote Appropriate Treatment of Hazardous Waste	• Indicate measures and promotion methods for the appropriate treatment of hazardous industrial wastes.	• Promote co-processing which utilizes waste as fuel and /or raw material. • For hazardous industrial waste inappropriate for co-processing, detoxify at an IPAAM approved treatment facility and disposal of residue in ATRINI. • For HIW that cannot be treated, it will be taken to a treatment and disposal facility in another state, or properly stored on-site at the factory until a proper facility is prepared in Amazonas State.
Measure 2.3. Promote Co-processing	• Indicate promotion methods for co-processing, which is ideal for appropriate treatment /disposal of industrial waste.	• Indicate cement factory treatment methods for industrial waste and the measures necessary to do so. • In order to promote cement factory co-processing, it is necessary to foster companies (blenders) that will be able to blend the several kinds of wastes to be accepted by the cement factories.
Approach C. Strengthen Administration of Industrial Waste Management • There are personnel and technical vulnerabilities in the current system for IWM centred on IPAAM. Strengthening the administration of this system is a critical issue.		
Measure 1. Strengthen Organizational Capacity of IW Management	• Indicate a measure to strengthen IPAAM and SUFRAMA, which are responsible for IWM in Amazonas State.	• Appoint an officer in charge of IWM at the Environmental Monitoring Management Section (GMAM) at IPAAM. • The IWM officer will work with Information Analysis Management (GEAI) to develop and manage a database in which to enter and manage licenses of waste service companies (WSC_DB). • SUFRAMA will establish an Industrial Waste Management Group (IWM Group) and officially appoint IWM officers. • The IWM officers will work with the IT engineer (CGMOI: Modernization and Informatics General Coordination/SAD: Administration Deputy Superintendence) and develop a waste inventory database (WI_DB). • Analyze the data in the WI_DB and work with IPAAM to submit a PIM IWM Report to IBAMA and the State Public Ministry.
Measure 2. Improve	• Know the WSCs holding environmental licenses and the	• Enter WSCs currently using various activity codes under the newly established standardized codes (33 - -)

Management System of Waste Service Companies	activities therein and indicate a plan to eliminate non-licensed companies and activities.	and manage these. • Systemize conditions to obtain a license to operate as waste treatment company. • Instruct WSCs to obtain an operational license for collection and transportation, intermediate treatment, reuse and recycling, and final disposal as appropriate with their actual activities. • Develop a database of WSCs (WSC_DB) and enter approved companies. Make information on these approved WSCs available to waste generators. • Regulate both against generators contracting non-licensed companies and licensed companies conducting inappropriate treatment and disposal activities.
Measure 3. Strengthen Regulations	• Indicate measure for regulating inappropriate treatment/disposal.	• Make use of the database and its licensing and management system to promote regulation against improper treatment/disposal by WSCs. • Promote regulations against improper treatment/disposal through securing contractual agreements between waste generators and only licensed companies.
Measure 4. Strengthen Cooperation between Administration, Generators and WSCs	• Make a measure for administration, generators and waste service companies to collaborate in order to realize the "establishment of appropriate industrial waste management system".	• Promote cooperation between administration bodies. • Promote cooperation between administration and waste generators. • Promote cooperation between administration and waste service companies. • Strengthen cooperation between administration, generators, and waste service companies (WSCs).
Approach D. Improve Business Environment for Waste Service Companies • It is necessary to promptly improve the business environment currently restricting waste service companies and promote the proper treatment and disposal of industrial wastes.		
Measure 1. Make Manaus Municipal Landfill Fee-based	• Make the Manaus Municipal landfill, which accepts the largest amount of industrial waste, fee-based by collecting a fee necessary for appropriate disposal.	• SUFRAMA in cooperation with IPAAM will work with Manaus Municipality so that a dedicated site for Non-HIW & Non-inert IW can be constructed and make the necessary efforts to achieve construction. • Once it is constructed, SUFRAMA and IPAAM will work to ensure that Manaus City strictly manages the site to keep municipal waste separate from Non-HIW & Non-inert IW, and also so that a fee is collected to recover the necessary investment and operation costs.

Measure 2. Regulate Improper Waste Disposal	• Once the administration prepares a system for IWM, indicate a regulation measure against the improper treatment/disposal for industrial waste generators and WSCs to properly conduct these services.	• IPAAM will work with SUFRAMA for waste generators to recognize the need for costs corresponding with proper treatment and disposal. • IPAAM will strengthen its regulation against non-licensed entities. • IPAAM will strengthen its regulation against improper treatment/disposal by licensed companies.
Measure 3. Publicize, Educate and Train Generators and WSCs	• Indicate measure to publicize, educate and train waste generators and WSCs.	• IPAAM will actively publicize information on WSCs to waste generators (factories). • IPAAM will also provide training and guidance on technical information to promote the 3Rs in factories. • IPAAM will hold seminars for WSCs and provide training and guidance on technical information for appropriate treatment and disposal.
Measure 4. Cultivate Preferred Waste Service Companies	• Indicate measure to cultivate preferred waste service companies.	• Proactively inject good examples from advanced states such as Sao Paulo and improve the business environment for WSCs. • Consider introducing the system now used by many Prefectures in Japan for “Promotion of Preferred Waste Service Companies”.

5.4.2 Understand Actual Treatment and Disposal of Industrial Waste

In order to obtain an environmental license for PIM requested by the Public Ministry of Amazonas State, it is necessary to get a clear picture of treatment and disposal of industrial waste generated from PIM. Surveys of 187 factories and 90 waste service companies were completed in this study to clarify the conditions and practices related to industrial waste; however, it was not possible to reveal the destination of residues from intermediate treatment, reuse and recycling activities. The following measures will be taken to resolve this point.

Measure 1. Establish waste manifest system

Measure 2. Report location of final destination

Measure 3. Ensure submission of all waste inventories

a. Establish Waste Manifest System

The waste manifest (WM) is the basic document used to facilitate the waste manifest system. The WM provides information about the wastes and their origin, transport, and destination, and establishes joint responsibility between the generator, transporter and receptor, including final destination of the waste. The diagram below visualizes the concept of the proposed waste manifest system.

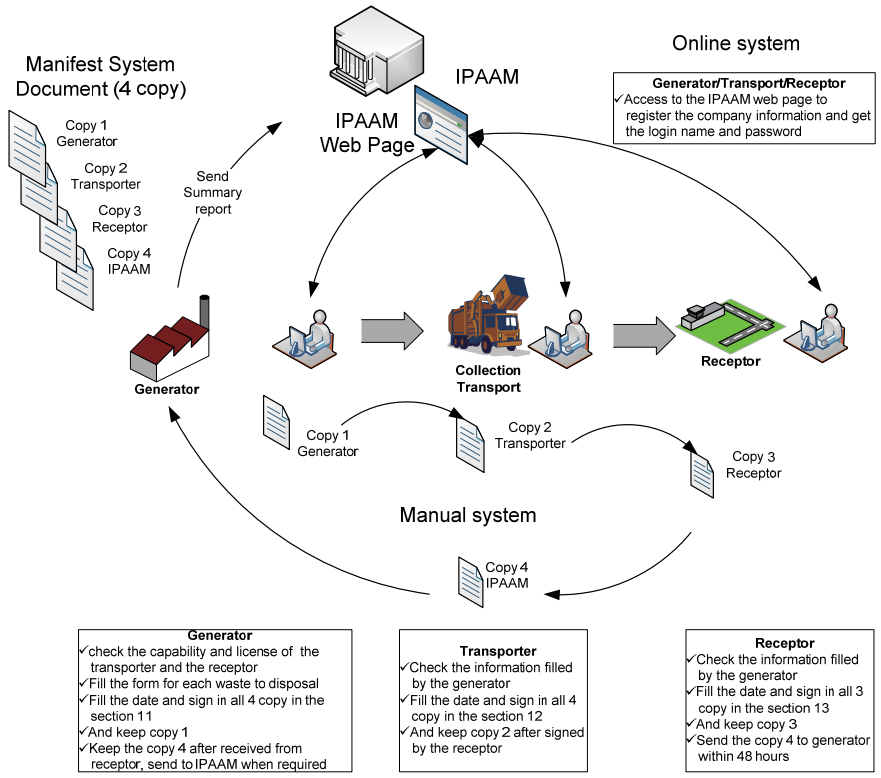


Figure 5-7: Proposed Waste Manifest System

The waste manifest (WM) is issued in four copies by the waste generator, who keeps one and sends the others to the transporter together with the waste. The transporter keeps one copy of the WM and delivers the waste and remaining two copies to the waste receptor. Finally, the receptor receives the waste, keeps one copy of the WM and returns the last one back to the generator, completing the cycle. IPAAM will indicate which sheet will remain with each respective party.

Although the generator issues the original WM, a manager will be contracted to oversee the service. The WM should be issued specifically for each type of waste, even when several types are transported in a same load or when several loads of the same waste are transported together. Furthermore, even when several loads are transported by the same transporter or delivered to the same receptor, each load should be accompanied by a specific WM.

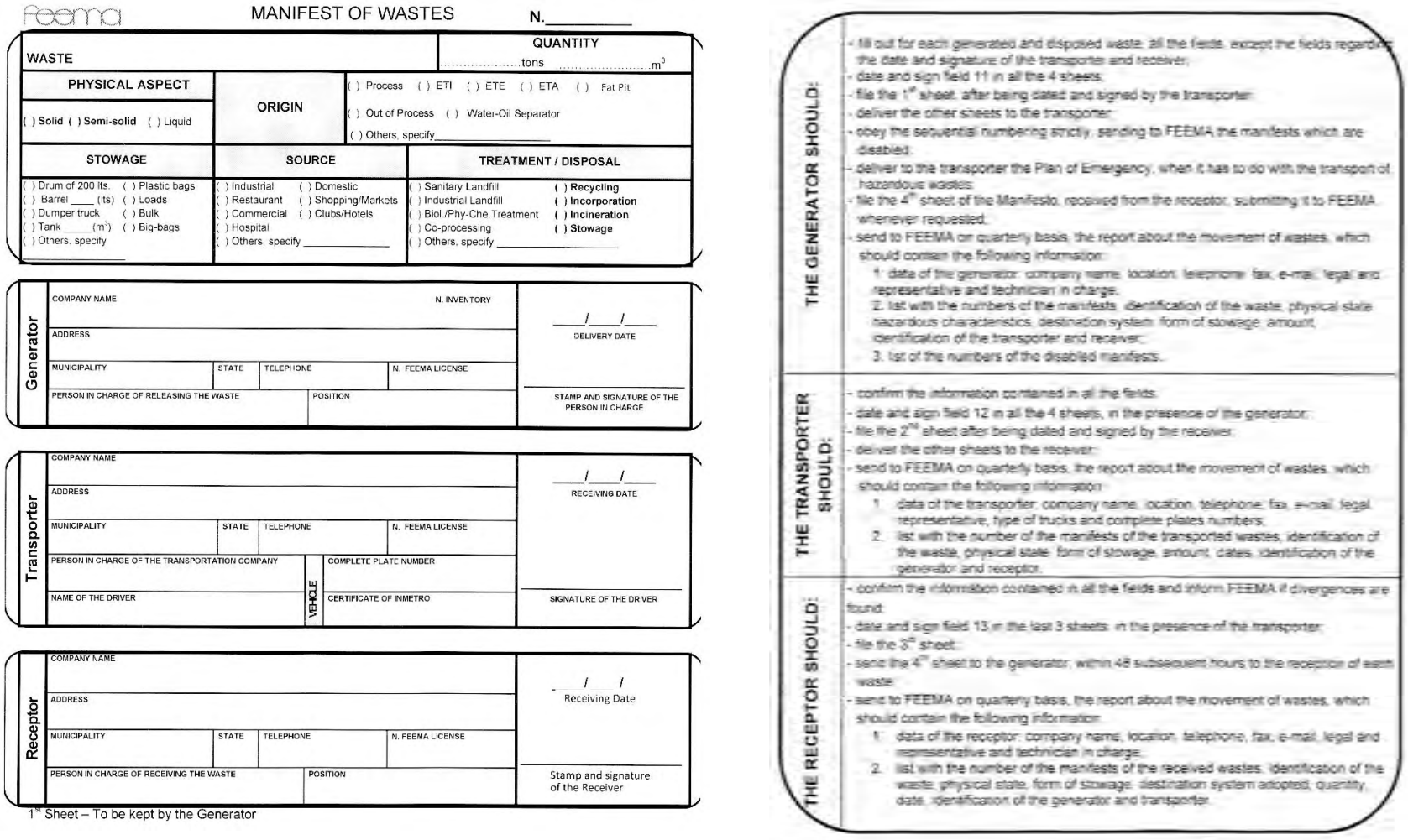
IPAAM will designate a unique serial number for each set of the waste manifest (4 copies) which also identifies the waste generator. This is to prevent fraud, such as any deviation from the required protocol.

All generators, transporters and receptors, public or private, in the waste manifest system will be linked to the IPAAM web page. Since the generator may receive the 4th copy of the WM, and as such, will be show up twice, IPAAM will need to define the relationship of the four (4) copies each time to avoid confusion.

The protocol of transferring and receiving the wastes within the waste manifest system is established specifically in each case at the discretion of IPAAM depending on the hazard and the amount of wastes generated by a factory's activities. General and public solid wastes are usually excluded, so the system is applied to the industrial plants' systems and their health services as well as the owners of construction sites, but excludes the domestic waste generated in those plants.

IPAAM will supply the generator with instructions, together with the serial number, and the forms or a model to make the forms.

The waste manifest form used in Rio de Janeiro is shown in the following figure.



feema

MANIFEST OF WASTES N._____

WASTE | QUANTITY ……tons ……m^3

PHYSICAL ASPECT: ( ) Solid ( ) Semi-solid ( ) Liquid

ORIGIN: ( ) Process ( ) ETI ( ) ETE ( ) ETA ( ) Fat Pit; ( ) Out of Process ( ) Water-Oil Separator; ( ) Others, specify_____

STOWAGE: ( ) Drum of 200 lts. ( ) Plastic bags; ( ) Barrel ____ (lts) ( ) Loads; ( ) Dumper truck ( ) Bulk; ( ) Tank _____(m^3) ( ) Big-bags; ( ) Others, specify _____

SOURCE: ( ) Industrial ( ) Domestic; ( ) Restaurant ( ) Shopping/Markets; ( ) Commercial ( ) Clubs/Hotels; ( ) Hospital; ( ) Others, specify _____

TREATMENT / DISPOSAL: ( ) Sanitary Landfill ( ) **Recycling**; ( ) Industrial Landfill ( ) **Incorporation**; ( ) Biol./Phy-Che. Treatment ( ) **Incineration**; ( ) Co-processing ( ) **Stowage**; ( ) Others, specify _____

Generator

COMPANY NAME | N. INVENTORY

ADDRESS

MUNICIPALITY | STATE | TELEPHONE | N. FEEMA LICENSE

PERSON IN CHARGE OF RELEASING THE WASTE | POSITION

____/____/____ DELIVERY DATE

STAMP AND SIGNATURE OF THE PERSON IN CHARGE

Transporter

COMPANY NAME

ADDRESS

MUNICIPALITY | STATE | TELEPHONE | N. FEEMA LICENSE

PERSON IN CHARGE OF THE TRANSPORTATION COMPANY | VEHICLE | COMPLETE PLATE NUMBER

NAME OF THE DRIVER | CERTIFICATE OF INMETRO

____/____/____ RECEIVING DATE

SIGNATURE OF THE DRIVER

Receptor

COMPANY NAME

ADDRESS

MUNICIPALITY | STATE | TELEPHONE | N. FEEMA LICENSE

PERSON IN CHARGE OF RECEIVING THE WASTE | POSITION

____/____/____ Receiving Date

Stamp and signature of the Receiver

1st Sheet – To be kept by the Generator

THE GENERATOR SHOULD:

- fill out for each generated and disposed waste, all the fields, except the fields regarding the date and signature of the transporter and receiver;
- date and sign field 11 in all the 4 sheets;
- file the 1st sheet, after being dated and signed by the transporter;
- deliver the other sheets to the transporter;
- obey the sequential numbering strictly, sending to FEEMA the manifests which are disabled;
- deliver to the transporter the Plan of Emergency, when it has to do with the transport of hazardous wastes;
- file the 4th sheet of the Manifesto, received from the receptor, submitting it to FEEMA whenever requested;
- send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information:
  1. data of the generator: company name, location, telephone, fax, e-mail, legal and representative and technician in charge;
  2. list with the numbers of the manifests, identification of the waste, physical state, hazardous characteristics, destination system, form of stowage, amount, identification of the transporter and receiver;
  3. list of the numbers of the disabled manifests.

THE TRANSPORTER SHOULD:

- confirm the information contained in all the fields;
- date and sign field 12 in all the 4 sheets, in the presence of the generator;
- file the 2nd sheet after being dated and signed by the receiver;
- deliver the other sheets to the receiver;
- send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information:
  1. data of the transporter: company name, location, telephone, fax, e-mail, legal representative, type of trucks and complete plates numbers;
  2. list with the number of the manifests of the transported wastes, identification of the waste, physical state, form of stowage, amount, dates, identification of the generator and receptor.

THE RECEPTOR SHOULD:

- confirm the information contained in all the fields and inform FEEMA if divergences are found;
- date and sign field 13 in the last 3 sheets, in the presence of the transporter;
- file the 3rd sheet;
- send the 4th sheet to the generator, within 48 subsequent hours to the reception of each waste;
- send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information:
  1. data of the receptor: company name, location, telephone, fax, e-mail, legal and representative and technician in charge;
  2. list with the number of the manifests of the received wastes, identification of the waste, physical state, form of stowage, destination system adopted, quantity, date, identification of the generator and transporter.

Figure 5-8: Waste Manifest form (FEEMA - Rio de Janeiro)

b. Reporting Location of Final Destination

The State of Amazonas requires an operational license to be issued to create and submit the forms needed for a waste manifest. During the period until a waste manifest system has been established, IPAAM (administrator) shall demand both the Factory (generator) and the WSC (receptor) to report a final destination for their waste as follows:

- The Final Destination for industrial waste generated from PIM in the State of Amazonas will be one of the following.
    1. One of two final disposal sites in the area, although they are without environmental licenses.
    2. Cement factory or co-processing which uses waste was construction material.
    3. Treatment and disposal outside of the State of Amazonas.
- IPAAM will instruct the generator to require receptors of their waste, including collectors, recyclers and intermediate treatment operators, to report final destination. Then require that the final destination of wastes be written on the application for operational license.
- IPAAM will instruct all waste service companies (receptors) to report the final destination of wastes to the factories where the wastes were generated. Then require that the final destination of wastes they were contracted to receive is written on the application for operational license.

The above framework is shown in the figure below. IPAAM will cooperate with SUFRAMA to aggregate the final destinations reported by both the generator and receptor, check this against the waste stream made in this study, and clarify any resulting issues.

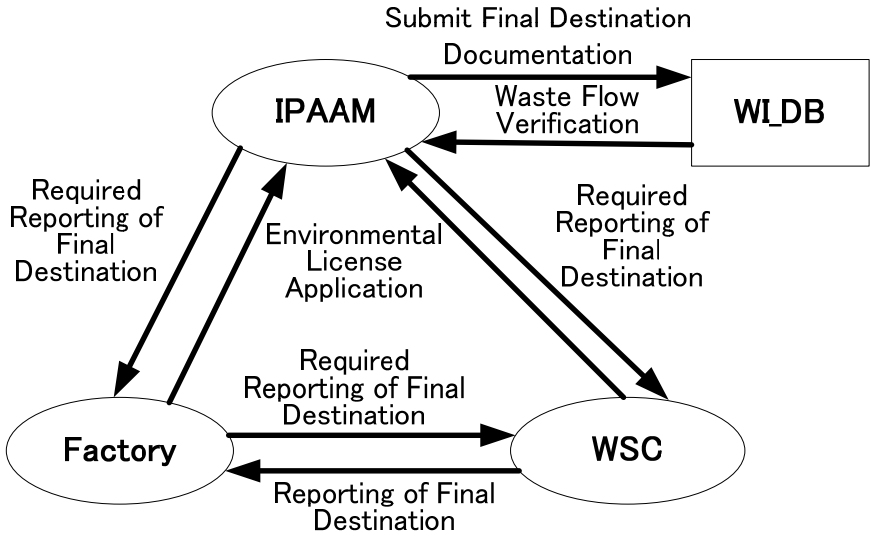


Figure 5-9: Final Destination Reporting and Application

c. Ensure Submission of All Waste Inventories

The following measures will be taken to ensure that all PIM factories submit waste inventories (WI).

- At SUFRAMA, the “Industrial Waste Management Group (IWMG)” will cooperate with CGMOI to construct a system to manage waste inventories.

- Each factory will designate someone who is responsible for waste management, who will prepare the WI and submit it to SUFRAMA.
- Establish reporting forms needed for the database management system created in this study.
- Hold a seminar on the proper way to fill in the reporting forms so that the person responsible for waste management at each factory can understand.
- Furthermore, distribute an electronic format of the same form to each factory so that each factory can enter and submit the waste inventory online.

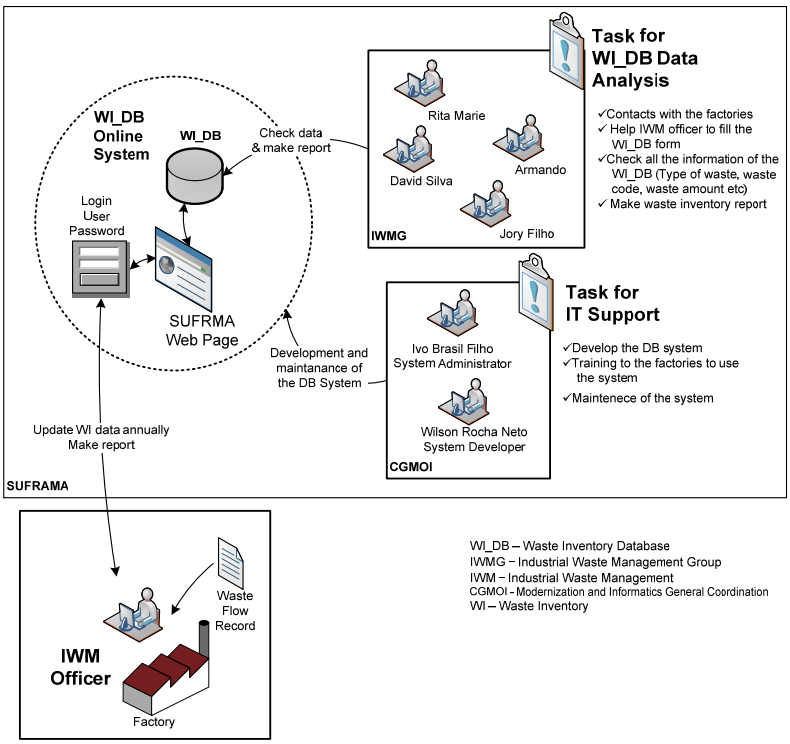


Figure 5-10: Waste Inventory Management Structure

5.4.3 Secure Industrial Waste Final Destination

The following measures will be taken in order to ensure final destination for industrial waste from the PIM factories.

Measure 1. Move forward with construction of new industrial waste landfill

Measure 2. Implement provisional measures until new landfill is operational

During the period until a licensed final destination has been constructed, take the following measures.

Measure 2.1 Use Manaus municipal landfill

Measure 2.2 Promote appropriate treatment of hazardous waste

Measure 2.3 Promote co-processing

a. Move Forward with Construction of New Industrial Waste Landfill

a.1 Waste and Landfill Categories

The following table shows the categorization of wastes that are accepted in landfills in Brazil.

Table 5-25: Waste types and landfills in Brazil

Target Landfill Type	Landfill/ABNT/NBR Guideline*1	Remarks
1. Hazardous Waste (Class I waste)	• Hazardous Waste Landfill • NBR 10157/87 – Landfill for Hazardous waste (Class I waste)	• Equivalent to a strictly controlled landfill in Japan. As in Japan, Brazil has few of these authorized landfills. There are some in Sao Paulo State and Paraná State. • Presently, in more developed states like Sao Paulo, Rio de Janeiro --and similar to Japan -- direct disposal (without treatment) of hazardous wastes is discouraged.
2. Class II-A/ non-inert industrial waste	• Non-hazardous waste landfill • NBR 13896/97 – Landfill for Non-hazardous waste (Class II waste)	• Equivalent to a controlled landfill in Japan. • ABNT/NBR guidelines have only two standards: hazardous and non-hazardous. Therefore, non-hazardous industrial waste and non-hazardous municipal waste have the same landfill standard. However, depending on the State, non-hazardous, non-inert industrial waste landfills have a different standard than municipal landfills. It is recommended that the municipal landfill be separate and strict management and monitoring appropriate to the standard be observed.
3. Class II-A & B/ municipal waste	• Municipal Landfill • NBR 13896/97 – Landfill for Non-hazardous waste (Class II waste)	• Equivalent to a controlled landfill in Japan. • The ABNT/NBR guidelines are the same as non-hazardous wastes.
4. Class II-B/ inert industrial waste	• Non-hazardous waste landfill • NBR 13896/97 – Landfill for Non-hazardous waste (Class II waste)	• In Brazil, there is no equivalent to Japan's standard for stable landfill. It is the same as non-hazardous and municipal garbage landfill. • Even in strictly run states, if an item can be verified to be inert, it is accepted at the municipal landfill.

Note: *1: Not CONAMA but a standard[1] established by each state according to ABNT/NBR guideline

[1] In Rio De Janeiro State INEA (Ex-FEEMA) established the following standards for landfill:
- DZ 1311 – Destination of IW
- IT 1304 – Licensing of industrial landfill
- DZ 1313 – Impermeabilization (bottom and upper liner) of landfills

a.2 Develop a Landfill on a Priority Basis

At present, the municipal landfill is operating even though it has not obtained an environmental license, yet it has accepted a large amount of industrial waste. It is essential to have a place of final disposal responsible for municipal waste management and related agencies are now working to move ahead with the construction of an municipal waste landfill with a operation license and, separately, industrial waste management.

An industrial waste landfill differs from a municipal waste landfill in that the risk of hazardous waste entering the site. To avoid hazardous waste the industrial waste landfill is carefully chickening waste characteristics prior to accepting it for disposal. On the other hand, the municipal waste landfill is not checking the incoming waste. In accordance, there is a considerable risk that the municipal landfill is receiving hazardous industrial waste for disposal if it accepts industrial waste. In order to avoid such a risk, it is necessary to dispose of industrial waste in a dedicated landfill of its own.

Waste would be roughly divided into the following 3 categories for an industrial waste landfill, using waste categories in Brazil.

1. Hazardous Industrial Waste (HIW): Class I HIW
2. Non-hazardous and non-inert industrial waste: Class II-A: Non-HIW /Non-inert
3. Non-hazardous and inert industrial wastes: Class II-B: Non-HIW /Inert

Of these, if the waste can be proven to be non-hazardous, inert industrial waste, there is no problem to dispose of it in the municipal waste landfill. For hazardous waste, it should be treated (detoxified) as much as possible before disposal, as is done in Japan and developed States of Brazil. Also, according to estimates, generation amount of HIW is limited to 119.9 ton/day in 2009 and 157.5 ton/day in 2015; it should be reduced and treated through co-processing and intermediate treatment as much as possible. For items that present extraordinary challenges to treat, they should be transported to another State for treatment and disposal.

Based on the above statements, a non-hazardous, non-inert (Class II A: Non-HIW /Non-inert) industrial waste landfill should be prepared as soon as possible. A hazardous industrial waste landfill is also of great importance, however dealing with any accidents that could happen would create a significant challenge, it is necessary to make careful considerations and prepare a great deal of time to select the site, carry out environmental, natural and social surveys, make the basic design, conduct an EIA, hold a public hearing, do the actual facility design, and construct it.

For the planning and design of non-inert (Class II A: Non-HIW /Non-inert) industrial waste landfill, the following standards made by CETESB/SP (Lo Companhia Ambiental Do Estado De Sao Paulo, Environmental Company of State of Sao Paulo) could be referred due to the lack of a federal standard:

- Rules for the environmental/geological evaluation of the site chosen for the landfill (Norma para avaliação geológica/ambiental do sítio escolhido para aterro de resíduos)
- Project standard for industrial waste landfill (Norma para projeto de aterro industrial)

As for the planning and design of a hazardous industrial waste landfill NBR 10157 Dec/1987 (Hazardous Waste Landfills – Criteria for design, construction and operation) shall be referred.

a.3 Promote the Construction of a New Industrial Landfill

In Brazil as well as Amazonas State the government has a policy not to develop a new industrial waste landfill by themselves. Instead they promote a private company to develop it. The construction and operation of a new landfill will require a massive investment and operation costs. A private company will have to collect an appropriate disposal fee from users so that they can recover their investment and carry out proper disposal practices. In order to facilitate the construction of a landfill by a private company, SUFRAMA and IPAAM should cooperate with the Municipality of Manaus and FIEAM and others according to the following measures.

- The Manaus city landfill currently disposes industrial waste free of charge. As long as these conditions persist, the environment is not welcoming to an investor that might construct an industrial waste landfill that can properly dispose of such waste. This is also important to encourage generators of waste to practice the 3Rs and reduce their waste. Therefore, a system to charge for disposal should be introduced, quickly constructing the framework where dischargers bear the necessary cost to dispose of waste properly.
- Appropriate treatment and disposal comes hand-in-hand with a reasonable cost burden. In order to foster an environment that promotes appropriate treatment and disposal, it is necessary to implement measures that eliminate improper disposal and prevent illegal dumping.
- Upon implementing the above measures, to construct a new landfill, it is necessary to explore tax benefits and financial aid schemes such as subsidies.

When planning the new industrial waste landfill, it will be necessary to make the following social and environmental considerations.

Social Environment:

- Does not require resident relocation. Furthermore, select an area apart from residential areas to the greatest extent possible.
- Locate the site in an area apart from the airport whilst minimizing the transportation distance from PIM.
- Select an area that will not affect public facilities or cultural sites.
- Select an area that does not cause community severance, such as a natural conservation area.
- Select an area with minimal potential impact on natural disaster by avoiding steep slopes.

Natural Environment:

- Select an area with little impact on the ecosystem.
- Avoid areas susceptible to soil erosion, and select an area with minimal potential impact on geological features.
- Select an area that will not affect groundwater, lakes or rivers (igarape).
- Select an area that will not impact the local landscape.

Pollution Countermeasures:

- Take sufficient air pollution control measures such as dust prevention measures.
- Make a thorough investigation into groundwater, lakes and river (igarape) water pollution prevention measures.
- Take sufficient measures against soil contamination.
- In the construction stage, propose a plan to alleviate negative affect of construction, such as air pollution, noise pollution and water pollution.

b. Implement Provisional Measures until New Landfill is Operational

b.1 Use Manaus Municipal Landfill

b.1.1. Construction of ATRINI: Non-HIW & Non-inert Temporary Disposal Site

Manaus City landfill is in principle non-hazardous and disposes of industrial waste discharged from PIM along with municipal waste. Also, there is no disposal fee collected, so there is little reason for dischargers to reduce their waste, and recyclable waste is disposed of without recycling.

As mentioned above, in order to avoid the risk of mixing hazardous industrial waste for disposal, it is necessary to carefully manage the characteristics of the wastes accepted separately from municipal waste. Thus, it is necessary for IPAAM to work with SUFRAMA and FIEAM to construct a special Non-HIW & Non-inert IW temporary disposal site (ATRINI) in the municipal landfill, asking that non-HIW and non-inert waste be carefully managed apart from municipal solid waste and non-HIW and inert waste, and provide support for construction. The discharger will bear the disposal fee, an amount that will cover the construction and sustained operation of the site (ATRINI). The fee for appropriate disposal will encourage dischargers to reduce their costs, increasing the necessity to reduce through recycling and thus contribute to the promotion of 3R. The concept of the non-HIW and non-inert industrial waste disposal site is shown in the figure below.

Also, to promote its construction, IPAAM will have to work with the state's Public Ministry to make a Terms of Agreement Procedure (TAC) with the concerned parties such as the Municipality of Manaus and SUFRAMA.

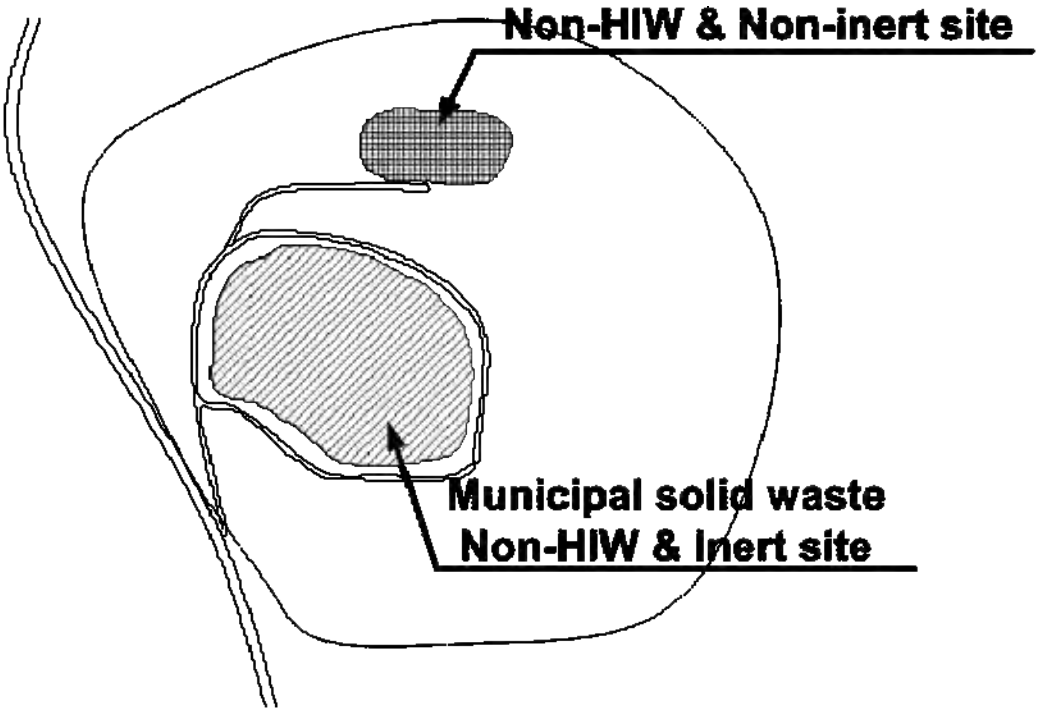


Figure 5-11: Conceptual Drawing of the Dedicated Site for Non-HIW and Non-inert IW

Also, for the construction of a dedicated site for non-hazardous and non-inert industrial waste, consideration is given to the following points.

- Forecasting the amount of municipal waste and non-hazardous, non-inert industrial waste that will enter the site, calculate the area of the landfill sections that will be required for both.
- Select a location to landfill non-hazardous, non-inert industrial waste that will minimize any impact on the surrounding area and take any necessary environmental countermeasures.
- Design the ATRINI (Non-hazardous & non-inert industrial waste temporary disposal site) according to the project standard[1] made by CETESB/SP (Lo Companhia Ambiental Do Estado De Sao Paulo, Environmental Company of State of Sao Paulo) due to the lack of a federal standard for the design of a non-hazardous & non-inert industrial waste disposal site.
- Construct an enclosure around the perimeter of the non-hazardous, non-inert industrial waste to specify the section for final disposal.
- Assign attendants to direct collection vehicles to the proper place to dump non-hazardous, non-inert industrial waste separately from municipal waste.
- Operate the ATRINI according to the operation standard[2] made by CETESB/SP because there is no federal standard for the operation of a non-hazardous & non-inert industrial waste disposal site.

[1] Project standard for industrial waste landfill: Norma para projeto de aterro industrial

[2] Operation standard for industrial waste landfill: Norma para operação de aterro industrial

- Conduct regular surveillance of landfill section for non-hazardous, non-inert industrial waste.

b.1.2. Ensured Industrial Waste Management

After constructing the non-HIW & non-inert temporary disposal site (ATRINI), the city of Manaus will rigorously manage the disposal of industrial waste at that site as follows:

1. Prohibit the disposal of hazardous industrial waste (HIW), and keep strict restriction on transportation.
2. Non-HIW & Non-inert waste is disposed of at ATRINI, establish and collect the fees needed for necessary costs (construction, operation, etc). The entrance to the hauling roads to the ATRINI and municipal waste sites will be separate and marked so the proper road is clear after weighing is completed.
3. Non-HIW & Inert waste, if clearly marked by the IPAAM, will be disposed of at the municipal waste site. A separate fee will be established from that for Non-HIW & Non-inert waste.

b.2 Promote Appropriate Treatment of Hazardous Waste

Until the new disposal site is operating, the following measures will be taken for a final destination for hazardous industrial waste.

1. First, promote co-processing to use waste as fuel or raw materials.
2. HIW that can not be co-processed will be treated at an IPAAM-approved facility and the residue disposed of at ATRINI.
3. For HIW that can not be disposed of by the above methods, they will be transported to a treatment/disposal facility in another state, or properly stored within the factory until an appropriate treatment/disposal facility is constructed in the Amazonas State.

The above policies for hazardous industrial waste are shown in the figure below along with non-HIW final destination (FD).

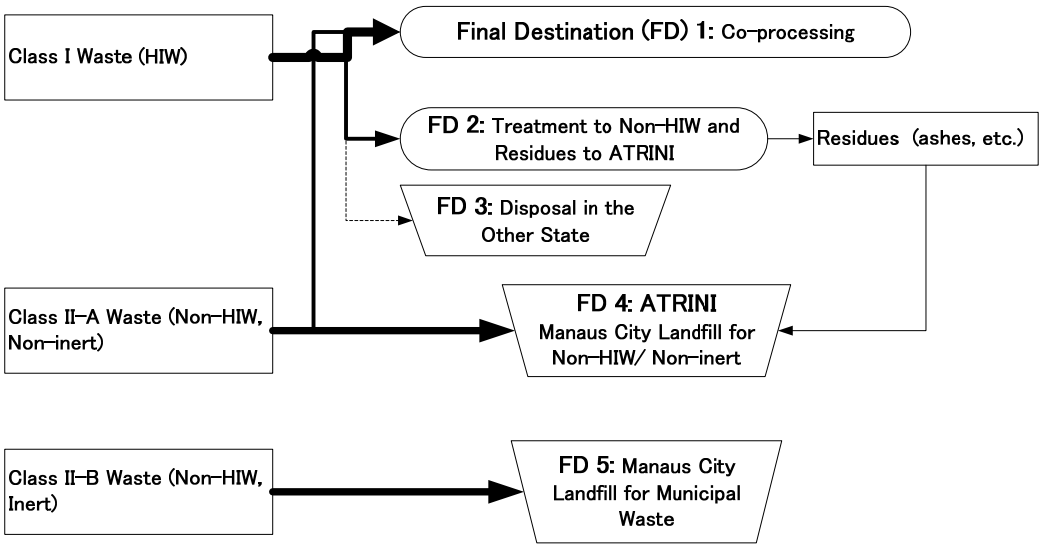


Figure 5-12: Industrial Waste Final Destination (FD)

b.3 Promote Co-processing

Co-processing is the use of waste as raw material, as a source of energy, or both, to replace natural mineral resources (material recycling) and fossil fuels such as coal, petroleum and gas (energy recovery) in industrial processes, mainly in energy intensive industries (EII) such as cement, lime, steel, glass, and power generation. Waste materials used for Co-processing are referred to as alternative fuels and raw materials (AFR).

b.3.1. Concept of Co-processing

Co-processing is a proven sustainable development concept that reduces demands on natural resources, reduces pollution and landfill space, and thus contributes to reducing the environmental footprint. Co-processing is also based on the principles of industrial ecology, which considers the best features of the flow of information, materials, and energy of biological ecosystems, with the aim of improving the exchange of these essential resources in the industrial world.

The following table presents types of co-processing:

Table 5-26: Types of Co-processing

Types of Waste	Types of Recovery	Substitution	Examples
Energy Content Waste (Carbon, hydrogen)	Energy	Fossil energy	• Paint & Solvents • Waste oil • Waste plastics
Both Energy (Carbon, hydrogen) and Material Content Waste (CaO, Fe_2O_3, Al_2O_3, etc.)	Energy and Material	Fossil energy Raw material	• Waste tire
Material Content Waste (CaO, Fe_2O_3, Al_2O_3, etc.)	Material	Raw material	• Sludge • By-product gypsum • Molding sand • Slag

b.3.2. Benefits of Co-processing

In summary, the benefits of co-processing are:

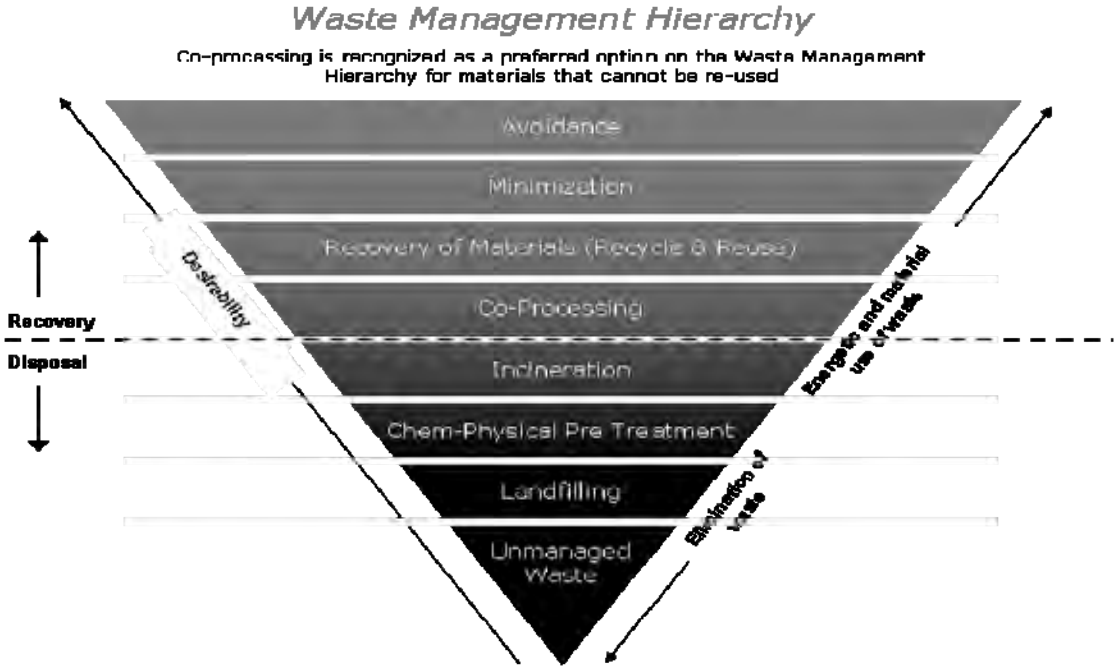
- to conserve natural (non-renewable) resources of energy and materials,
- to reduce emissions of greenhouse gases in order to slow global warming and demonstrate a positive impact on integrated environmental indicators, such as the ecological footprint,
- to reduce the environmental impacts of the extraction (mining or quarrying), transporting, and processing of raw materials,
- to reduce dependence on primary resource markets,
- to save landfill space and reduce the pollution caused by the disposal of waste, and
- to destroy waste completely eliminating potential future liabilities.

b.3.3. Waste Management Hierarchy

Co-processing contributes to the industrial competitiveness, is a complementary technology to concepts such as cleaner production or recycling and should be considered as a treatment

alternative within an integrated waste management concept. Some energy intensive industries offer co-processing as a sustainable waste management service. It is usually more cost effective to adapt existing facilities of energy intensive industries than building new waste treatment capacities thereby reducing waste management cost to society.

The waste management hierarchy (see figure below) shows that Co-processing is a recovery activity which should be considered after waste minimization and recycling; Co-processing ranks higher in this hierarchy in comparison to disposal activities such as landfilling or incineration.



Source: Guidelines on Co-processing Waste Materials in Cement Production (GTZ- Holcim Ltd,), March 2005

Figure 5-13: Waste Management Hierarchy

b.3.4. Co-processing Waste in Cement Production

Different types of wastes have been successfully co-processed as alternative fuels and raw materials (AFR) in cement kilns in Europe, Japan, USA, Canada, and Australia since the beginning of the 1980s.

Main destinations of wastes in co-processing in the cement factory are;

- Organic substances: Thermal destruction in the kiln
- Heavy metals: Incorporation in the clinker

Main constituents of the clinker, which is semi-fabricated material of the Portland cement, are the following four components: CaO, SiO_2, Al_2O_3 and Fe_2O_3.

Waste and/or by-products, which contain these four components to some extent, are theoretically able to be utilized as raw material for Portland cement.

Normally cement kilns use coal as fuel. Wastes and or by-products having a certain level of calorific value can be used a substitute of fuel. In addition, ashes generated from these combustible wastes and by-products are incorporated into the clinker. No new wastes

generated characterize co-processing in the cement kiln. Furthermore, in the firing process in the kiln, temperature and retention time at the main burner are generally more than 1,450 ℃ and more than 15 seconds respectively. Many types of hazardous wastes and products can be safely changed to non-hazardous material at this high temperature. However, in case, these wastes and/or by-products contain chlorides, alkaline component and heavy metals, it is necessary to correspond to these cases.

Table 5-27: Example of constituents of the Portland cement product, raw material and wastes

		Main chemical components (%)			
		SiO_2	Al_2O_3	Fe_2O_3	CaO
Standard Portland Cement		20～23	3.8～5.8	2.5～3.6	63～65
Natural raw material	Limestone	～4	～2	～2	47～55
	Clay	45～80	10～30	3～10	～5
	Silica stone	70～95	2～10	～5	5～20
Wastes and by-products	Coal ash	40～65	10～30	3～10	5～20
	Blast furnaces slag	20～45	10～20	～5	30～60
	Sludge (e.g. sewer sludge)	20～50	20～50	5～15	5～30
	Molding sand	50～60	5～15	5～15	～5

Source: Chiaki Sasaki, Taiheiyo Cement

According to the annual report in 2007 of the National Association of Cement Industry (SINDICATO NACIONAL DA INDUSTRIAL DO CIMENTO), the present status of co-processing in the cement industry is mentioned as follows. In Brazil, the first practices took place from the 90s on, and CONAMA Resolution 264/1999 was established in 1999 as the legal framework for co-processing. Out of the existing 65 cement plants, 48 are integrated factories, i.e., with kilns for the production of clinker, and another 17 plants have grinding facilities of clinkers and mixing facilities of gypsum; however they don't have kilns.

Out of the 48 integrated factories, 35 are properly skilled and licensed by the environmental organizations of the located states to co-process wastes The country generates around 2.7 million tons of hazardous waste a year, coming from the most varied industrial sectors, many of those do not treat and dispose by any proper environmental treatment and thus, in the end it is contaminating the soil, the air and both underground and surface waters. Current capacity of co-processing of hazardous wastes is two million and five hundred thousand tons per year (2.5 million tons). The industry treated one million tons of hazardous wastes in 2007. It was under current capacity.

The main wastes co-processed by cement industry are as follows:

- Waste plastics
- Waste refractory products
- Acid dusts
- Waste paper and cardboard
- Contaminated soil
- Wooden wastes
- Construction wastes
- Waste oils and grease
- Waste paints and solvents

- Petrochemical wastes
- Dust
- Waste tires
- Wastewater treatment sludge

One of the main wastes co-processed by the industry are waste tires, which are observed dumped on the rivers banks and unused lands. Only in 2007, around 1.6 thousand tons of waste tires were utilized in cement kilns as a substitute of fuels; corresponding to approximately 32 million tons per year.

As stated above, utilization of co-processing service of waste in cement kilns holds in CONAMA Resolution 264/1999 as the federal government level. In addition, at the Amazonas state level, the co-processing of wastes includes categorization of pollutant sources in granting of the environmental licenses by IPAAM. Therefore the co-processing of wastes is clearly defined by law and rule. In CONAMA Resolution 264/1999, the following permits and licenses are required in order to acquire permit of co-processing operation.

- Installation license of the kiln based on the federal regulation
- Acceptance of combustion test of the kiln
- License or permit based on the state regulation where the kiln is located

Emission standards of exhaust gas from cement kiln in co-processing of wastes should be applied in the standard in the CONAMA Resolution No. 264/99.

Table 5-28: Emission standards of exhaust gas from cement kiln in co-processing of wastes

Parameter	Maximum emission standard
HCl	1.8kg/h or 99 % reduction
HF	5 mg/Nm^3
CO	100 ppm (one hour value)
Particulate Matter	70 mg/Nm^3
THC (as propane)	20 ppm
Hg	0.05 mg/Nm^3
Pb	0.35 mg/Nm^3
Cd	0.10 mg/Nm^3
Tl	0.10 mg/Nm^3
As+Be+Co+Ni+Se+Te	1.4 mg/Nm^3
As+Be+Co+Cr+Mn+Ni+ Pb+Sb+Se+Sn+Te+Zn	7.0 mg/Nm^3

Note: Oxygen concentration is 7% (dry base) except particulate matter. Oxygen concentrate of maximum emission standard of particulate matter is 11% (dry base)
Source: CONAMA Resolution 264-1999

Mixing and pre-storage company for co-processing in the cement kiln is obliged to acquire an environmental license from the competent authority of the state government. In this regard, the company should provide the following information to the competent authority.

- Name of company and address of plant
- Main products and services
- Location of acceptance of wastes, laboratory, storage and disposal facilities (including plan hereafter)

- Description about procedure of acceptance of wastes, sampling & analysis, storage and treatment of generated residues
- Classification, characteristics, amount and treatment method of in-coming wastes
- Physical and chemical analysis results of in-coming wastes, plan of analysis
- Facility and procedure of safety management
- Risks upon loading and unloading of wastes, risks upon opening of package, effect of breakdown of equipment and blackout, exposure of wastes
- Prevention measures for accidental firing and reaction of combustible, reactive and rejected wastes
- Transportation pathway of wastes in the plant
- Plan in case of closure of plant and plan after closure of plant
- Wastewater treatment system

b.3.5. Co-processing in the cement industry in Manaus

There is only one cement producer in the state of the Amazonas. This company commenced operation in 1986. It is one of ten cement plants of the Joao Santos group which is the second largest cement producer in Brazil. According the National Association of Cement Industry, its production amount of Portland cement in 2007 was 683 thousand tons. They have one kiln 4.4m in diameter×74m in length. In the questionnaire survey, they answered that the waste they accept is mainly waste tires, foundry sand and treatment sludge. At this moment, they are unable to calculate how many tons of acceptable wastes are generated in this area and they are not sure of the continuity of receiving acceptable wastes in the future. Therefore they may not start full-scale co-processing business at this moment. In addition, co-processing may face cost competition with incineration service and final landfill.

b.3.6. Situation of co-processing of wastes in the cement industry in Japan

The cement industry in Japan has been treating and utilizing several types of wastes. The table below shows the amount of wastes and by-products co-processed in the industry. The industry utilized approximately 31 million tons of wastes in 2007, which is equivalent to 43.5 % of the amount of cement products. Japan is continuing with "3R which is Reduce, Reuse and Recycle of wastes" to establish a recycling-oriented society. The concept of industrial clusters is drawing attention at this moment as one of the measures for establishing the recycling-oriented society. The concept of industrial clusters is to reduce the wastes through the linkage of industries. In this process, the generated wastes (output) from one industry are converted to resources (input) of other industry.

Since the cement industry can utilize a variety of wastes from many industrial sectors, the industry is recognized as an important industry and one of the core industries in a recycling-oriented society. In addition, the industry currently accepts ash of municipal wastes. Then the industry produces special cement of which incineration ashes of municipal wastes and sewage sludge are the primary raw material.

Table 5-29: Historical record of amount of products and wastes utilized in the Japanese cement industry

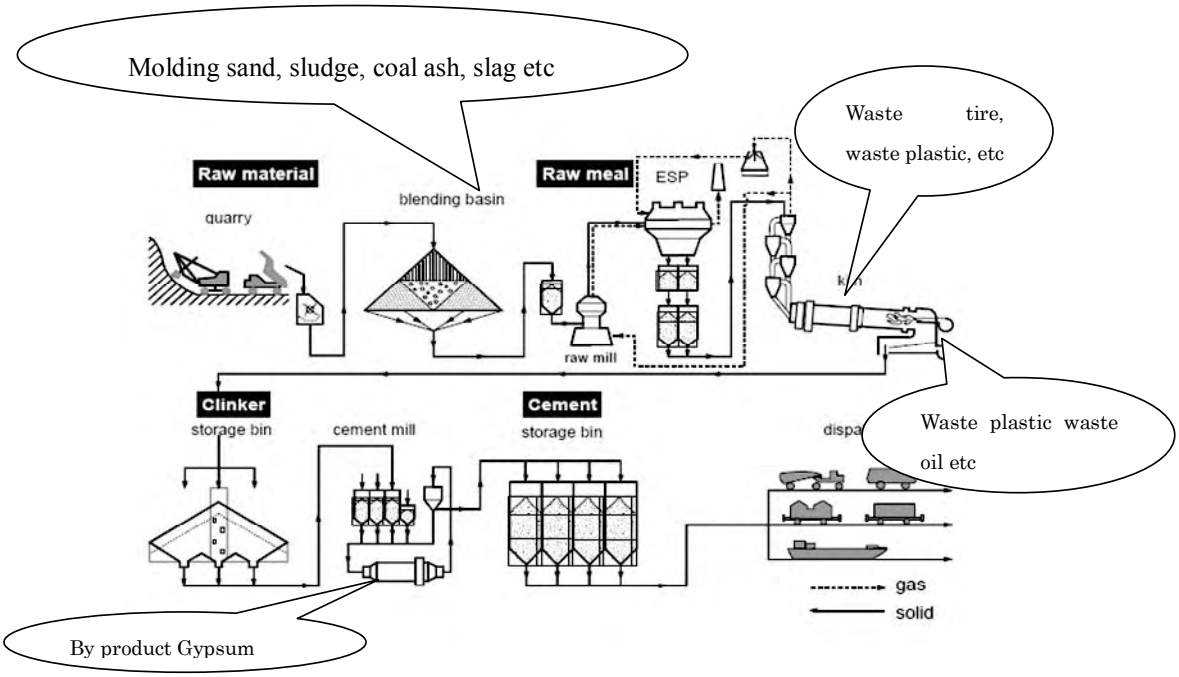
Unit: thousand ton/year

		2000	2001	2002	2003	2004	2005	2006	2007
Waste	Blast furnace slag	12,162	11,915	10,474	10,173	9,231	9,214	9,711	9,304
	Coal ashes	5,145	5,822	6,320	6,429	6,937	7,185	6,995	7,256
	By-product gypsum	2,643	2,568	2,556	2,530	2,572	2,707	2,787	2,636
	Waste oil	359	353	352	411	450	447	474	479

	Waste wood chips	2	20	149	271	305	340	372	319
	Waste plastics	102	171	211	255	283	302	365	408
	Waste tires	323	284	253	230	221	194	163	148
	Others	6,623	6,928	6,923	7,265	8,781	9,124	10,181	10,170
	Total	27,359	28,061	27,238	27,564	28,780	29,513	31,048	30,720
	kg/ton-cement	332	355	361	375	401	400	423	436
Cement Product	Production	82,373	78,119	75,479	73,508	71,682	73,931	73,170	70,600
	Rate(Waste/Cement)	33.2	35.9	36.1	37.5	40.1	39.9	42.4	43.5

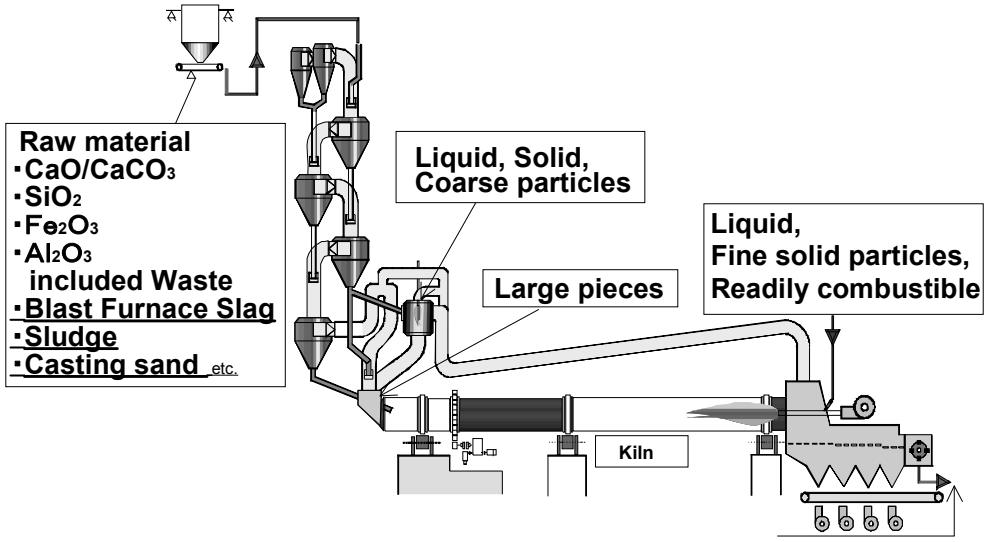
Source: "Cement Sector Actions through the Asia-Pacific Partnership on Clean Development and Climate", Taiheiyo Cement Corporation, Japan Cement Association

The following figure shows the types and feeding places of waste in a cement plant. The figure also illustrates the relationship of the cement plant and the blenders of the wastes. Characteristics of each waste and sources are different so, in order to accept many kinds and sources of wastes, it is necessary to mix and regulate the constituents and convert them to be acceptable for the cement plant. These blenders of wastes are taking active roles in the waste management business.



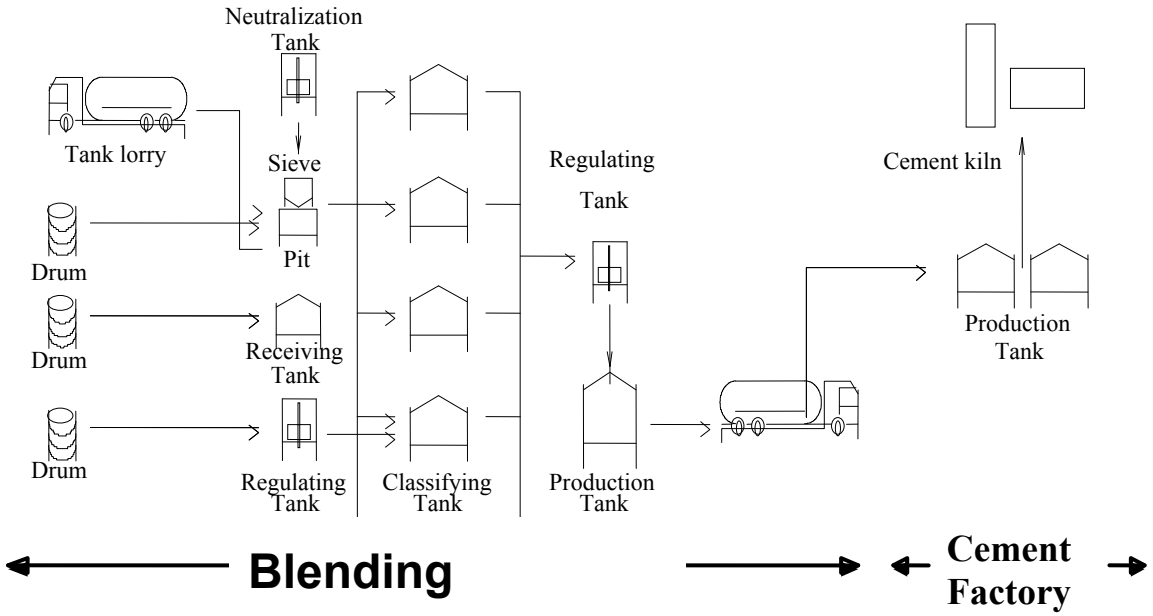
Source: Guidelines on Co-processing Waste Materials in Cement Production (GTZ- Holcim Ltd,) March 2005, Japan Cement Association

Figure 5-14: Types and feeding places of waste in the cement plant



Source: JICA Preparatory Study of "The Study for the Development of an Integrated Solution Related to Industrial Waste Management in the Industrial Pole of Manaus"

Figure 5-15: Type and feeding places of waste in the cement kiln (detail)



Source: JICA Preparatory Study of "The Study for the Development of an Integrated Solution Related to Industrial Waste Management in the Industrial Pole of Manaus"

Figure 5-16: Cement plant and blender of wastes

5.4.4 Strengthen Administration of Industrial Waste Management

The following measures will be taken to strengthen IW Administrative Capacity.

Measure 1. Strengthen organizational capacity of IW management

Measure 2. Improve management system of waste service companies (WSCs)

Measure 3. Strengthen regulations

Measure 4. Strengthen cooperation between administration, generators and waste service companies (WSCs)

a. Strengthen Organizational Capacity of IW Management

Although there is a sufficient legal and regulatory mechanism for industrial waste management at the federal level, the law enforcement capacity of the state government for industrial waste management is weak and limited, particularly in terms of available human resources. This section discusses the measures to strengthen organizational capacity of IPAAM and SUFRAMA for industrial waste management in the State of Amazonas.

a.1 Strengthening Organizational Capacity of IPAAM

In the State of Amazonas, the Environmental Monitoring and Management Section (GMAM) of IPAAM is responsible for IWM administration as a part of its duties as shown below:

- Environmental monitoring
- Performance evaluation of the activities with environmental licenses
- Implement response measures to remedy improper activities against the environment

The personnel responsible for this wide range of environmental management activities are: 3 chemists, 2 biologists, 1 civil engineer, 1 economist and 1 fishing expert. There is no personnel specifically assigned to industrial waste management. In this respect, IPAAM should undertake the following measures to improve the current IWM administration.

- Officially assign the officer responsible for IWM administration with the specified duties of registration, licensing and supervision of WSCs and waste inventory management and analysis.
- The IWM officer will collaborate with the IT engineer of the Information Analysis Management Section (GEAI) to develop the WSC Database (WSC_DB).
- The IWM officer will be responsible for handling the inquiries from WSCs concerning WSC registration/licensing, as well as the inquiries concerning the information on WSC available in the database.
- The IWM officer will also be responsible for issuing and revoking WSC license in collaboration with the GMAM monitoring officer and the other relevant officers in IPAAM
- In cooperation with SUFRAMA, the IWM officer will analyze the waste inventory database (WI_DB), which will be developed by SUFRAMA to identify the real time status of industrial waste management at PIM.
- The IWM officer will collaborate with the SUFRAMA officer in charge to improve and update the WI_DB and its guidelines.

a.2 Strengthening Organizational Capacity of SUFRAMA

SUFRAMA has formed an Industrial Waste Management Group (IWM Group) dedicated to industrial waste management at SUFRAMA and three SUFRAMA officers, who have been assigned as the counterpart members of this study since September 2009, joined the IWM Group. As of May 2010, it has not yet been decided to which department the group will be attached. It will be officially established within the fiscal year of 2010 to strengthen its IWM system.

At this moment, the waste inventories submitted by factories are managed by only one engineering officer belonging to the Division of Engineering and Architecture Projects Analysis Coordination (COPEA) of SUFRAMA. This officer is currently assigned to handle over 100 waste inventories from the factories while working on other tasks. Although he is trying his best to aggregate and analyze the enormous amount of waste inventory data, it is not possible to sufficiently comply with the duties provided in CONAMA Resolution 313.

SUFRAMA was requested by the Public Ministry of Amazonas State in 2001 to obtain an environmental license for the Industrial Districts, so it is essential to identify and analyze the current conditions of IWM in PIM. That is why SUFRMA requested the factories in PIM to submit waste inventories since before enforcing CONAMA Resolution 313.

Considering these conditions, SUFRAMA should take the following actions in collaboration with IPAAM to strengthen its organizational capacity of IWM.

- Officially establish the Industrial Waste Management Group (IWM Group) with official appointment of 3 staff members responsible for IWM in PIM.
- The IWM officers will work with the IT engineer in the information management group (CGMOI: Modernization and Informatics General Coordination) of the Administration Deputy Superintendence (SAD) to develop the waste inventory database (WI_DB).
- The IWM officers will be responsible for handling the inquiries from waste generators (factories) concerning the waste inventories and the information in the database.
- Working together with IPAAM in analyzing the data in the WI_DB, IWM officers will prepare a "PIM Industrial Waste Management Report" for submission to IBAMA and the State Public Ministry.
- The IWM officers, in collaboration with IPAAM, will encourage and guide PIM factories to submit waste inventories.
- The IWM officers, working closely with IPAAM, improve and update the WI_DB and its guidelines, as appropriate.

b. Improve Management System of Waste Service Companies (WSCs)

b.1 Improvement on the Categorization of Waste Management Service Licenses and Development of WSC Database

The fundamental method of properly supervising WSCs is to establish and strictly implement a licensing/registration system that clearly specifies the requirements for providing waste management services. However, due to the present WSC licensing/registration system's complicated categorization of waste management services over a variety of different fields, it is not useful for regulators (e.g. IPAAM and SUFRAMA) themselves or for WSCs; therefore it exists only in name and not fully in practice.

To improve this situation, the current licensing/registration system has to be integrated and simplified so that not only the regulators can easily manage it, but also so that the WSCs themselves, as well as the factories, can easily understand it. To do so, the study recommends a new integrated and simplified licensing system under the license categories shown in the table below.

Table 5-30: New Waste-related License Codes

Code	Main Category	Code	Sub-category	Classification (Types of Waste)
33	Municipal Waste Management	3301	Collection and Transportation	A (HW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3302	Intermediate Treatment	A (HW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3303	Reuse and Recycle	B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3304	Final Disposal	B (Non-HW & Non-Inert), C (Non-HW & Inert)
34	Industrial Waste Management	3401	Collection and Transportation	A (HIW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3402	Intermediate Treatment	A (HIW), B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3403	Reuse and Recycle	B (Non-HW & Non-Inert), C (Non-HW & Inert)
		3404	Final Disposal	B (Non-HW & Non-Inert), C (Non-HW & Inert)

Under this new license system, WSCs are primarily categorized into 2 (two) categories, i.e. those who deal with municipal waste and industrial waste. Subsequently, they are further categorized into 4 types according to what types of waste services they provide, i.e. (1) collection and transportation, (2) intermediate treatment, (3) reuse and recycling and (4) final disposal. Furthermore, they are specified by the types of waste they handle, namely: A (HW), B (NON-HW, NON-INERT), and C (NON-HW, INERT). In applying for obtaining WSC licenses, the applicants are required to specify the waste management services they provide in accordance with this new category with the other required information while all such information will be immediately entered into the WSC database.

This new license categorization system is user-friendly for both regulators and applicants. The application procedure for WSC licensing will be simplified while the regulators can easily supervise the WSCs. Furthermore, for waste generators who are obligated to contract waste handling to licensed companies, it is easier to select the proper WSCs according to the type of wastes they handle and the type of work they are licensed to conduct.

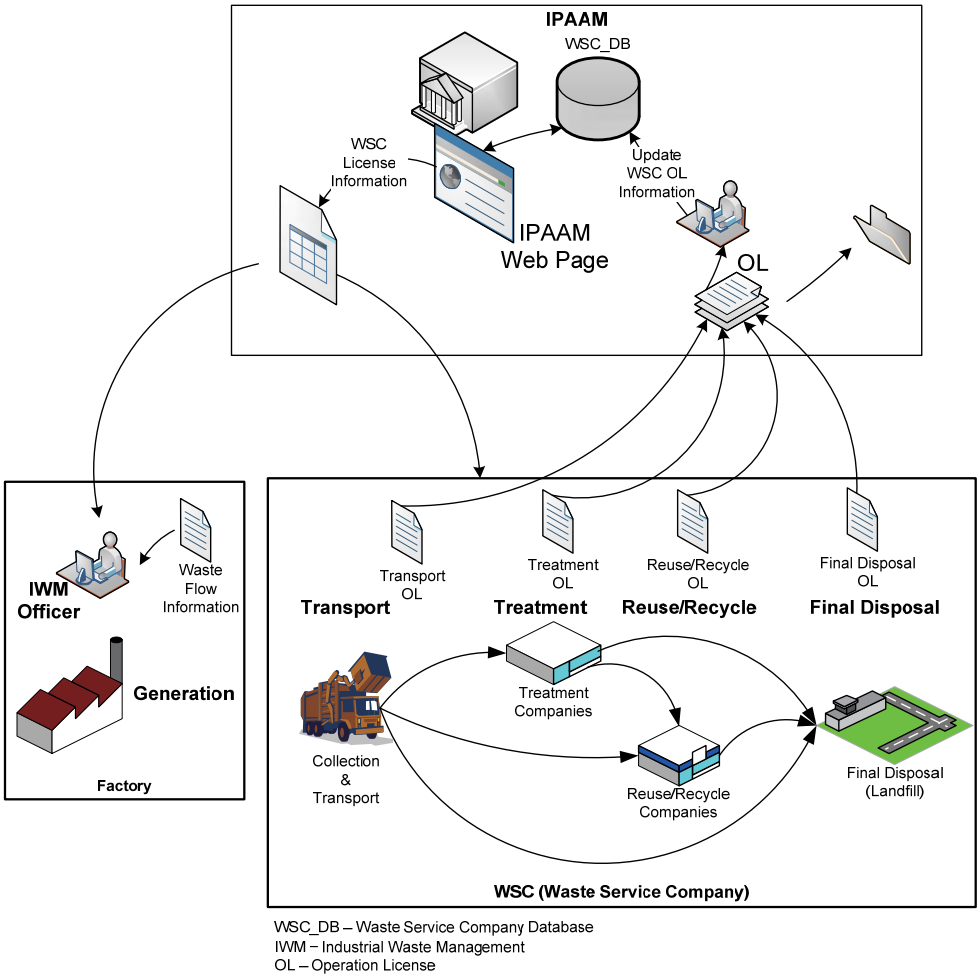


Figure 5-17: Waste Service Company Database (WSC-DB)

b.2 License Application and Licensing/Registration Procedure

The license application will be made in accordance with "the Guidelines for WSC License Application and Registration" (hereinafter, "Guidelines"), which is provided in the next Chapter. A set of uniform application forms will be prepared for use by WSCs. To simplify the application procedure, the application forms will be made available on the website in an editable, electronic document format so that the applicants can apply via the Internet.

In granting the WSC licenses, every application will be examined in accordance with the licensing criteria that will be specified by categories of services provided and types of wastes handled. Every applicant is required to submit the necessary information and data required by the criteria that will be available in the guidelines. In granting the licenses for intermediate treatment, reuse/recycling, and final disposal services, the conditions of relevant facilities and equipment have to be strictly examined to ensure that they have enough capabilities of providing the waste services they apply for licensing. In this respect, a facility and its operation standards should be determined for intermediate treatment, reuse and recycling, and final disposal of waste in accordance with the types of waste handled.

The regulators (IPAAM and SUFRAMA) are also required to monitor and supervise the activities of licensed WSCs by obligating them to submit annual activity reports, and conducting on-site inspection of their facilities.

b.3 Disclosure of the Information on Licensed WSCs to PIM Factories and Business Entities

The information about licensed WSCs will be made publicly available by uploading to the IPAAM website their key information, e.g. the company name, types of services provided, types of wastes handled and so forth so that the factories and business entities can select proper WSCs. SUFRAMA is also required to disclose this information actively to PIM factories to raise their awareness of the WSCs.

c. Strengthening Regulations

c.1 Overview

In order to properly manage industrial waste, the regulatory enforcement role of IPAAM is essential as the public entity primarily responsible for industrial waste management administration.

According to the relevant laws and regulations, IPAAM holds strong authority to control WSCs as well as waste generators including the factories in PIM in relation to industrial waste management, such as:

- Granting licenses for WSCs;
- Monitoring and supervising WSCs' compliance with license requirements;
- Expiration and/or revoking of the license and order of halting waste service operations in the case of non-compliance with the license requirements; and
- Issuance and expiration of environmental licenses of the factories in the case of non-compliance with the obligation to contract out industrial waste management to licensed WSCs.

By utilizing the existing legal/regulatory authorities and the new licensing/registration system for WSCs, IPAAM is able to further strengthen its direct law enforcement authority. However, more effective results will come from providing guidance and support to WSCs and factories so that both of them will voluntarily make their best efforts of proper industrial management.

c.2 Supervision of Waste Service Companies

c.2.1. Administrative Guidance and Strengthened Law Enforcement by IPAAM upon WSCs

IPAAM will promote license renewal of WSCs with the development of a complete WSC database while, in collaboration with SUFRAMA, confirming with PIM factories on whether they contract out industrial waste management to licensed WSCs through checking the waste inventory database. If they use non-licensed WSCs, IPAAM will instruct them to use licensed ones. Also, IPAAM must diligently keep the WSC database reliant through regular data entry and updating.

As for the licensed WSCs, IPAAM will investigate their service operations by the following measures, respectively:

- Operations of waste collection and transportation service companies will be reviewed at the time of license renewal, which will be determined in the new license system.
- Operations of intermediate treatment, reuse and recycling, and final disposal service companies will be reviewed annually based on the business operation report to be submitted by WSCs. On-site inspection will also be regularly carried out without prior notice to WSCs to confirm their proper service operations. In conducting on-site inspections, waste and final product samples from the treatment and recycling processes may be collected for laboratory analysis to investigate the compliance of WSCs with the relevant license requirements.
- When improper waste handling practices are discovered during the inspections, the actual conditions will be further investigated and provide specific instructions for corrective actions required in accordance with the license requirements.
- In case that IPAAM finds any illegal dumping or improper disposal activities by the reports from citizens or other information sources, it will immediately conduct site investigations. Once the perpetrator is identified, IPAAM will give administrative guidance or a restoration order. In the case that the perpetrator is a licensed WSC, strict administrative sanctions will be given to avoid any reoccurrence. In the case an offence is committed by a non-licensed company, they will be forced to halt their service operations. If it is a minor infraction, they will be encouraged to apply for licensing. But if it is a serious offence, the strict legal sanctions will be taken to strictly prohibit such activities.

c.2.2. Effective Utilization of License Renewal System for Assessment of the Operations of WSCs and Provision of Guidance

The current licensing/registration system requires WSCs to renew their licenses after a given period of time in order to continue operations. This license renewal system provides a good opportunity to review the operations of WSCs and provide guidance to them as needed.

Furthermore, it also provides that the license will be expired if the WSCs does not comply with the license requirements at the time of its renewal. Such a provision should be utilized to strictly control and correct waste management activities.

c.2.3. Establishment of Waste Acceptance Criteria by WSCs for Proper Screening of Waste before its treatment, reuse, recycling, and final disposal

The WSCs engaged in intermediate treatment, reuse and recycling and final disposal are advised to have their own waste acceptance criteria so that they can make contracts with those who bring wastes based on the compliance with these criteria. At the time of waste acceptance, they will visually confirm the types of waste or take some samples for laboratory analysis to check compliance with the criteria. In the event that the content does not comply with the criteria, they will ask those who bring the waste for corrective actions, or refuse waste acceptance if no change in their practices. It should be well understood by the WSCs that improper acceptance of waste leads to improper disposal of waste, which is a violation of licensing requirements for WSCs.

c.3 Supervision of Waste Generators (Ensuring the use of licensed WSCs)

When waste generators contract a third party to handle their industrial waste, they are obligated to contract it out to the licensed WSCs. In order for waste generators to select appropriate licensed WSCs, IPAAM will disclose the necessary information on licensed WSCs on its website. The necessary information includes company names, types of waste

services, and the types of wastes they handle. SUFRAMA will also promote the use of this information by factories in PIM for proper industrial waste management by conducting public relations activities about the industrial waste management regulations in PIM areas.

To ensure that PIM factories contract with the licensed WSCs, SUFRAMA will require them to specify the name and license number of the WSCs they use throughout the entire waste stream, ranging from collection to final disposal, when submitting the waste inventory.

Strict implementation of this rule will reduce and eliminate the activities of non-licensed WSCs while encouraging their license applications.

d. Strengthen Coordination between Administration, Waste Dischargers and Waste Service Companies (WSC)

d.1 Promote Cooperation between Government Bodies

d.1.1. Establishing Collaborative Organizations

In order to achieve appropriate industrial waste management in the State of Amazonas, it is important to solve the issues concerning to various stakeholders. To do so IPAAM, which is directly responsible for industrial waste countermeasures, needs to form a close relationship with the many other concerned government organizations.

In order to do so, the Technical Sub-Committee, which meets during the Weekly Meetings of this study, will be reorganized to establish a permanent standing (tentatively named) Coordination Committee for Proper Industrial Waste Management Promotion (CCPIWMP) headed by SUFRAMA and IPAAM.

d.1.2. Participating Members

The members of the CCCPIWMP committee will include IPAAM (which manages industrial waste related companies), SUFRAMA (which manages PIM factories), SEMULSP (which manages the Manaus city landfill), the State Public Ministry which brings charges against improper waste disposal), FIEAM (the State industries federation), CIEAM (Industries Center of Amazonas State), and CCINB-AM (Japanese-Brazilian Chamber of Commerce and Industry of Amazonas), inviting other concerned organizations as necessary based on issues that arise.

It is advisable to also establish the group structure, such as the Chairperson of Facilitator when establishing the group, as well as regular reporting and meeting periods, and topics for deliberation, and so forth.

d.2 Promote Collaboration between Administration and Waste Generators

The efforts of waste generators can not be underestimated in order to achieve proper IWM. This involves a number of issues, such as requiring generators to contract industrial waste treatment and disposal only to licensed WSCs, the submission of waste inventories, and, as will be required hereafter, the use of waste manifests.

In order to achieve these things, it is important that the administration actively work with waste generators in the following ways.

- Administration should ask the generator to establish systems for comprehensive responsibility and technical management on IW in the factory.
- Administration should ask the generator to assign an IWM officer. The officer will be responsible to deal with overall factory waste management such as on-site waste

generation control and recycling, efforts to ensure waste separation and WSC contracting, and inventory reporting and use of a manifest.

- The administration will offer training and guidance to foster personnel that will work toward establishing these systems and offer information about advanced factories that are actively promoting proper treatment and disposal and the 3Rs.
- Also, conduct training and offer guidance in key areas such as how to prepare and use waste inventories and waste manifests.
- Administration should establish a committee, as detailed below, where IWM officers from different factories can discuss good management practices, and send a representative to facilitate the exchange of information and offer support concerning proper IWM practices.

d.3 Promote Collaboration between Administration and WSCs

A key point to proper IWM is to optimize WSC practices not only through regulation and administrative guidance but through proactively supporting companies toward the appropriate activities and working with them to eliminate non-licensed entities and correct improper treatment and disposal practices.

To do so, the administration must be proactive in working with licensed companies in the following ways.

- Once the new licensing system for WSCs is publicized, efforts must be made to establish this new system by educating and providing training on the new application procedures.
- Provide support to establish a technical management system for WSCs that will encourage reuse and recycling as well as proper treatment and disposal practices. To do so will require making information on these practices widely available as well as training personnel in these areas.
- By using the WSC database, it will be possible to clamp down on non-licensed companies. Furthermore, the business environment for WSCs will be greatly improved through making information on licensed companies widely available to generators (i.e. factories) in an easy-to-use format.

d.4 Strengthen Cooperation between Administration, Generators and WSCs

In addition to the collaboration between administration and generators or WSCs, it is advisable to create a Proper Industrial Waste Management Promotion Committee (PIWMPC, tentatively named) for discussion between the three sides led by the above-mentioned CCCPIWMP. Establishing such a committee that meets regularly will facilitate the exchange of information necessary for proper IWM and building consensus on various issues among members of the committee.

To encourage this collaborative relationship, it is advisable to create a group that represents the common interests of the waste service companies (WSCs). This will be difficult due to the present competitive atmosphere, but once a new system to support licensed companies is fully established, the administration should provide support for the establishment of an industry group for WSCs. In the future, such an industry group will voluntarily act on their own behalf to introduce measures for proper IWM and to develop their activities further.

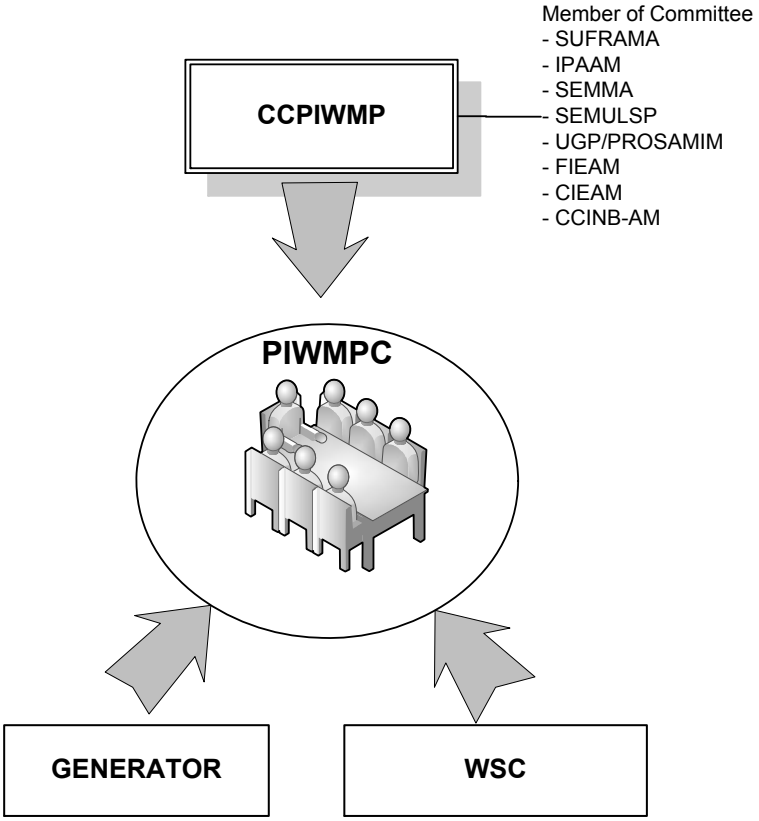


Figure 5-18: Relationship between the Coordination Committee for Proper IWM Promotion (CCPIWMP, tentative) and Proper IWM Promotion Committee (PIWMPC, tentative)

d.5 Vision for a New System of Treatment and Disposal

The world's manufacturing industry today is not only involved with the production of various products, but is working toward new changes or variations to their processes to reduce the amount and kinds of waste produced and trying to promote the 3Rs through the efficient use of waste as raw material or an efficient energy source. With a myriad of companies operating in PIM, as waste generators and WSCs improve their relations, they will be able to cooperate to construct a more intelligent system for treating waste as well as reuse and recycling. This presents new business opportunities. Particularly in the case of certain hazardous wastes, public-sector led initiatives could present more favorable conditions.

5.4.5 Improve Business Environment for WSCs

The following measures will be taken to improve the business environment to promote proper treatment and disposal of industrial waste.

Measure 1. Make Manaus municipal landfill fee-based

Measure 2. Regulate improper waste disposal

Measure 3. Publicize, educate and train generators and WSCs

Measure 4. Cultivate preferred WSCs

a. Make Manaus Municipal Landfill Fee-based

Industrial waste differs from municipal waste containing general waste from households in that it is generated through economic activity in pursuit of profits, and thus the treatment and disposal of industrial waste is fundamentally led by the polluter-pays-principal (PPP). However, in Manaus, even though the city landfill accepts a great deal of industrial waste, there is no fee charged for its disposal. This creates a number of problems which were found in this study, as outlined below.

- The on-site disposal rate is extremely low compared to that in other countries (4.2%[1] of the generation rate) and most waste is treated and disposed off-site. Much of that waste is brought to the Manaus City landfill.
- Despite the fact that the 3Rs are promoted as a national policy, the reuse and recycle rate in factories is only 1.6%[2] of the amount generated (of which, 1.4% is Non-HW and 2.1% is HW).
- The intermediate treatment facilities owned by WSCs use mostly used equipment and few environmental measures in order to drastically cut investment costs. Also, one private final disposal site was accepting waste without an environmental license and had to cease operations.
- Furthermore, cement factories are actively used for co-processing in other parts of Brazil, but almost not at all in the target study area.[3]

To encourage a reduction in the amount, or the reuse and recycling, of industrial waste generated, it is extremely important to introduce an incentive that will reduce treatment and disposal costs. There is an inherent cost to the proper treatment of industrial waste, but the cost burden lies with the waste generators, and this needs to be a basic condition for WSCs to operate. To do so, disposal of industrial waste brought to the Municipal landfill must be cost-effective, which requires the collection of a disposal fee needed to dispose of it properly. For this, IPAAM will have to cooperate with SUFRAMA to take the following measures.

- Make efforts to construct a dedicated landfill site for non-hazardous, non-inert industrial waste in Manaus.
- In order to bring about construction, work with the Amazonas State Public Ministry to form a TAC (Terms of Adjustment of Conduct) between the concerned parties and gain interim permission to operate a dedicated site for non-HW, non-inert IW.
- The City of Manaus must work to keep the management of the dedicated site for non-HW, non-inert IW separate from municipal waste, and collect the necessary fee to recover investment and operation costs.

b. Regulate Improper Waste Disposal

In order for WSCs in a healthy business environment to offer their services competitively, an environment must emerge in which they are able to charge an appropriate fee. First and foremost, there must be a transformation in thinking, namely amongst waste generators, regarding the need to pay for relative costs to properly treat and dispose of the waste they generate.

[1] Bangkok Metro Area, Thailand: 35.0% (2002 Study); Mie Prefecture, Japan: 53.9% (2000 Study).
[2] Bangkok Metropolitan Area, Thailand: 13.1% Non-HW, 1.6% HW (2002 Study).
[3] Study Team estimates the waste utilization rate for cement production is only 0.84%, whereas in Japan it is 43.5%.

Meanwhile, it is essential to stamp out the flourishing practices of non-licensed waste service companies that are able to charge unreasonably low fees by cutting corners and undermining proper treatment and disposal, but also to monitor and direct licensed companies.

There are two types of non-licensed WSCs: those that never obtained a license at all, and those whose activities are outside that which they are licensed to perform. However, putting aside whether either of these is better than the other, such entities must recognize the need to obtain the proper license for their actual operations, and to do so, thereby resolving their non-licensed status.

It is essential for licensed companies to collaborate in uncovering improper treatment and disposal activities and bring it to the attention of authorities. Not only WSCs, but also factories must cooperate to ensure that the WSCs they contract are licensed and be diligent in tracking their waste to final destination through the use of the manifest system.

It will be possible to stamp out non-licensed companies and improper practices if factories ensure they are contracting licensed WSCs. Also, it is possible to prevent illegal dumping by clarifying the collection and transportation companies and ensuring they are licensed.

For companies engaged in intermediate treatment, reuse and recycling and final disposal, IPAAM will confirm that that their actual operations are in compliance with their licenses through annual reports and on-site inspections.

Meanwhile, treatment and disposal companies need to check and ensure that the wastes they receive from transportation companies are in accordance with the original contract based on their licenses.

If a company is discovered to be operating without a license, they must be immediately ordered to cease operations in accordance with the law, and assisted to obtain the proper license in the case of a minor infraction, or in the case of a serious offence, to cooperate with the proper authorities.

Should a licensed company be found to have conducted improper activities, after a thorough investigation of the facts, they will need to undertake actions to return conditions to their original state and carry out disposal in accordance with the law.

c. Publicize, educate and train generators and WSCs

Administration must collaborate with industrial groups and the person in charge of waste issues in the newly formed coordinating committee to educate, train and communicate with waste generators concerning the necessity of proper treatment and disposal, and also be sure they are aware of their responsibility for proper treatment and disposal as well as their responsibility to bear the corresponding costs. Administration must also collaborate with industrial groups to educate and train WSCs on proper operation practices and make sure they are aware of the necessity of proper treatment and disposal technology and their implementation.

Administration will support established industry groups for waste services to encourage voluntary activities such as publicizing and providing training for proper waste management.

d. Cultivate Preferred WSCs

Improvements to correct IWM are led by efforts to raise the level of waste service companies that are directly handling industrial waste. By cultivating preferred companies in that area, it effectively brings about improvement of the whole.

In order to encourage the emergence and cultivation of preferred companies, an effective policy, such as a system to promote preferred companies, will be introduced. This policy will select preferred companies as models which will raise the quality level of the overall industry of waste services. However, setting the selection requirements so high that the selection process becomes too complicated will not function as an incentive, so introduce incentives with the target in mind, such as advertising company names in a public venue or directly to waste generators or extending the validity of their licenses, or other preferential treatment measures.

Should conditions permit, such as having a firm licensing system in place or a reliable industry group, it may be effective to introduce a rating system, such as that used in Iwate Prefecture, Japan (see "Good Practice" in Chapter 6).

5.5 Project Evaluation

5.5.1 Implementation Plan

The implementation plan for the Master Plan (M/P) formulated in this study is summarized in the table at the end of this section.

SUFRAMA and IPAAM, as the counterpart organizations of this study which will implement the M/P, will consign the technical system of industrial waste management, namely the provision of facilities and equipment needed for treatment and disposal, to private interests. Accordingly, the M/P notes the appropriate components for the technical system to be provided by the private sector and puts the management system of the administration at the heart of providing guidance to correctly manage its operation and maintenance.

Based on this basic idea of the M/P, the implementation plan gives preference to the provision of the administration's management system. Furthermore, in this study, the following tools, which are seen as essential to develop the management system, were developed by the end of May 2010 and transferred to the appropriate organization:

- Development of a Waste Service Company Database (WSC_DB) as a tool to organize and manage waste service companies, as well as WSC_DB operation guidelines.
- Development of a Waste Inventory Database (WI_DB) to grasp the actual conditions of industrial waste management at generation sources (factories), as well as WI_DB operation guidelines.

Therefore, the first step of preparing the administration's management system has already begun. Furthermore, other parts of the M/P have also been initiated already. Moreover, particular issues which will require extra attention in the implementation plan (as shown in the figure below) are outlined, taking into consideration progress that has been made already in some areas.

a. (A) Understand Actual Treatment and Disposal of Industrial Waste

a.1 Measure 1) Establish Waste Manifest System

IPAAM will deal with the following based on the recommendations for the M/P

- Establish a standard format and system for the waste manifest in Amazonas State by the end of the year 2010.

- Plan the development of the online waste manifest, making use of the PROSAMIM budget. With that, the online waste manifest system is to be developed in the year 2011.

a.2 Measure 2) Report Location of Final Destination

As above, after a waste manifest system (WMS) for Amazonas State is formulated in 2010, the new system will make it possible to verify the site of final destination in 2011.

a.3 Measure 3) Obtain Complete Records of Submitted Waste Inventories

A trial test of the WI_DB system was conducted in May 2010. Based on the results of this trial, IPAAM will work with SUFRAMA to improve the WI_DB system and users guide from early 2011 and finalize them. Then, all PIM factories will be asked to make their waste inventories according to the WI_DB system and be submitted.

b. (B) Secure Industrial Waste Final Destination

b.1 Measure 1) Move Forward with Construction of New Industrial Waste Landfill

In relation to the introduction of a fee-based system at Manaus City Landfill, In January 2010 the Municipality of Manaus established the Municipal Law on Urban Cleansing Services (No. 1411, January 20, 2010). This law makes it possible to charge a higher fee for most industrial wastes than for municipal waste[1]. Consequently, this prepares the conditions for private companies to invest in the construction of a new industrial waste landfill.

According to IPAAM, the environmental study for non-hazardous (Class II) waste has been completed and private companies are now preparing to hold a public hearing. Therefore, this implementation plan calls for the new industrial landfill plans to be approved in 2011, complete construction in 2012 and begin operations in 2013.

b.2 Measure 2) Implement Provisional Measures until New Landfill is Operational

b.2.1. Measure 2.1) Use of Manaus Municipal Landfill

According to IPAAM, at the end of June 2010, a committee was established comprised of IPAAM, SEMMA, the Municipal Urbanization Department of Manaus, the Airport Authority, and others, to consider the possibility of constructing a dedicated section for non-hazardous, non-inert industrial waste (ATRINI). ATRINI will be constructed based on the decision of this committee.

The plan shows that ATRINI would begin operations in mid-2011, and once the private landfill mentioned above begins operations, ATRINI would be closed in early 2013. It will be necessary to rectify these plans as fit according to their respective progress.

b.2.2. Measure 2.2) Promote Appropriate Treatment of Hazardous Waste

The measures to appropriately treat hazardous wastes were formulated by the study team with the support of the C/P, taking into consideration current conditions of treating industrial waste in Manaus. Based on these measures, IPAAM will formulate a plan for the appropriate

[1] This is an impressively large law containing 198 provisions and is primarily concerned with the overall municipal cleansing services. The specifics of these provisions will take time before they are finalized, but it has been decided that a fee-based system will be introduced for the collection and disposal services of municipal waste. Furthermore, some wastes will be designated not as municipal waste but as large volume or special waste: 50 liters or more per day of non-hazardous, inert (Class 2-B) waste, 200 liters/day or more of non-hazardous non-inert (Class 2-A) waste, and hazardous (Class I) waste. In those cases, a city-approved waste service company will be able to charge a higher fee than for municipal waste.

treatment of hazardous wastes with special attention to current conditions. However, to implement the plan, first IPAAM must enforce the waste service companies (WSC) licensing management system and ensure that all WSCs obtain the proper license, therefore bringing sufficient transparency to what services are actually being performed.

b.2.3. Measure 2.3) Promote Co-processing

The process to promote co-processing is similar to the promotion of appropriate treatment of hazardous waste, above.

c. Strengthen Administration of Industrial Waste Management

c.1 Measure 1) Strengthen Industrial Waste Management Organizations

Measures to strengthen IPAAM and SUFRMA, the main organizations managing industrial waste, is already underway, to be completed in 2010.

c.2 Measure 2) Improve Management System of Waste Service Companies

The most important item to improve the management system of waste service companies is to firmly establish the system to register WSCs. This is best done as soon as possible, but the State Legislature will vote in October 2010, so the plan calls for this system to be established sometime in 2011. Once the system is in place, the WSC_DB will be constructed immediately and certain information about the licensed companies will be made public.

c.3 Measure 3) Strengthen Regulations

Once the information on WSCs is made public, IPAAM will put regulations in place to deal with non-licensed companies, as well as licensed companies which carry out improper waste disposal. Furthermore, IPAAM will work with SUFRAMA, FIEAM and others to regulate waste generators against outsourcing to non-licensed companies.

c.4 Measure 4) Strengthen Cooperation between Administration, Generators and Waste Service Companies

The measures recommended by the Study Team to strengthen cooperation between administration, generators and WSCs were formulated with the counterpart, taking into consideration the current conditions in Manaus. Based on this policy, IPAAM will discuss with related organizations the need to establish (1) a Coordination Committee for Proper Industrial Waste Management Promotion and (2) a Proper Industrial Waste Management Promotion Committee sometime in 2011 to act as the center for these relations.

d. Improve Business Environment for Waste Service Companies

d.1 Measure 1) Make Manaus Municipal Landfill Fee-based

As mentioned above, based on the Municipal Law on Urban Cleansing Services, the Municipality of Manaus is currently deciding the details supporting the provisions, establishing a city landfill fee, and selecting collection and disposal services for large volume and special wastes which will be treated as industrial waste. It is assumed that these decisions will be completed in 2010 and that the municipal landfill can introduce a fee-based system in 2011. It will be necessary to rectify these plans as necessary based on the progress of other plans, such as the construction of ATRINI.

d.2 Measure 2) Regulate Improper Waste Disposal

Until improper waste disposal is sufficiently regulated, both waste generators and waste service companies will need to be informed and instructed on the necessity for proper

disposal and the details of the WSC licensing management system. On that basis, improper waste disposal will be regulated.

d.3 Measure 3) Inform, Educate and Train Generators and WSCs

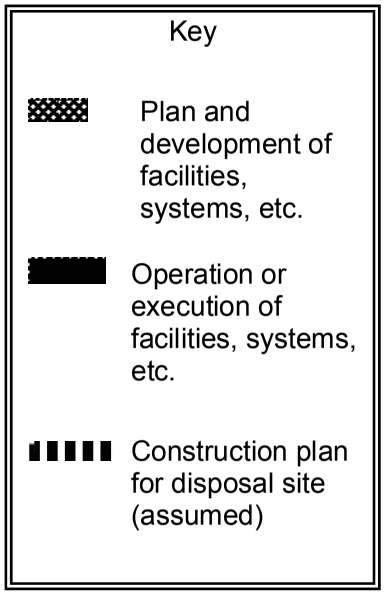
IPAAM will need to develop itself as an organization to inform, educate and train generators and WSCs on industrial waste management. On that basis, they will formulate a plan to carry out these tasks and develop the information, education and training tools needed, and then carry out the plan.

d.4 Measure 4) Cultivate Preferred Waste Service Companies

The first step to cultivate preferred waste service companies is to properly understand the good examples of waste management which currently exist in Brazil. On that basis, a plan to cultivate preferred WSCs will be formulated and carried out. When formulating the plan, consideration should be given to the good examples from Brazil and Japan introduced during the study.

Table 5-31: Implementation Plan

Notation	Implementation Plan	Activities	Executing Organization	Year 2010	2011	2012	2013	2014	2015
A. Understand Actual Treatment and Disposal of Industrial Waste									
A.1	Establish Waste Manifest System	Establish a standard format and system	IPAAM						
		Implement new waste manifest system (WMS)	IPAAM						
		Develop online WMS	IPAAM, INEA, etc.						
		Implement online WMS	IPAAM, INEA, etc.						
A.2	Report Location of Final Destination	Verify final destination through the operation licenses (OL) of generato	IPAAM, Generators						
		Verify final destination through OL of WSCs	IPAAM, WSC						
		Verify final desination through new WMS	IPAAM						
A.3	Obtain Complete Records of Submitted Waste Inventories	Develop the Waste Inventory Database (WI_DB) system	JICA Study Team, C/P						
		Test the WI_DB system	IPAAM, SUFRAMA						
		Improve and finalize the WI_DB system and users guide	IPAAM, SUFRAMA						
		Full implementation of the WI_DB system	IPAAM						
		Understand conditions of IWM for the State, and make report	IPAAM, SUFRAMA						
		Formulate State waste management plan	IPAAM						
B. Secure Industrial Waste Final Destination									
B.1	Move Forward with Construction of New Industrial Waste Landfill	Explore introduction of fee-based system at Manaus Municipal landfill	Municipality of Manaus						
		Introduce fee-based system at Manaus Municipal landfill	Municipality of Manaus						
		Explore options to assist in the contruction of new landfill	SUFRAMA, IPAAM, etc						
		Establish measures to prevent improper disposal and illegal dumping	IPAAM						
		Plan the new industrial waste landfill	Private Enterprise, IPAAM						
		Construct the new industrial waste landfill	Private Enterprise						
		Operate new landfill	Private Enterprise						
B.2 Implement Provisional Measures until New Landfill is Operational									
B.2.1	Use of Manaus Municipal Landfill	Plan section for non-hazardous non-inert industrial waste (ATRINI)	Municipality of Manaus, IPAAM, etc.						
		Construct ATRINI	Municipality of Manaus						
		Operate ATRINI	Municipality of Manaus						
B.2.2	Promote Appropirate Treatment of Hazardous Waste	Formulate policy for appropriate treatment of hazardous wastes	JICA Study Team, IPAAM						
		Formulate plan to promote appropriate treatment of hazardous wastes	IPAAM						
		Implement plan to promote appropriate treatment of hazardous wastes	IPAAM						
B.2.3	Promote Co-processing	Formulate policy to promote co-processing	JICA Study Team, SUFRAMA, IPAAM						
		Formulate plan to promote co-processing	IPAAM						
		Implement co-processing promotion plan	IPAAM						
C. Strengthen Industrial Waste Management System of Waste Service Companies (WSC)									
C.1	Strengthen Industrial Waste Management Organizations	Formulate policy to strengthen IWM organizations	JICA Study Team, IPAAM, SUFRAMA						
		Strengthen IPAAM's system for IWM	IPAAM						
		Strengthen SUFRAMA's system for IWM	SUFRAMA						
		Enforce industrial waste management	IPAAM, SUFRAMA, etc.						
C.2	Improve Management System of Waste Service Companies	Develop WSC licensing management system and database (WSC_DB)	JICA Study Team, IPAAM						
		Establish WSC licensing management system	IPAAM, etc.						
		Implement WSC licensing management system	IPAAM						
		Construct WSC_DB and publicize WSC information	IPAAM						
C.3	Strengthen Regulations	Regulate improper disposal activities by licensed/non-licensed WSCs	IPAAM						
		Regulate against outsourcing to non-licensed companies	IPAAM, SUFRAMA, FIEAM						
C.4	Strengthen Cooperation between Administration(A), Generators(G) and Waste Service Companies(WSC)	Formulate policy to strengthen cooperation between A, G and WSCs	JICA Study Team, IPAAM						
		Establish Coordination Committee for Proper IWM Promotion	IPAAM, SUFRAMA, FIEAM, etc.						
		Establish Proper IWM Promotion Committee	IPAAM, SUFRAMA, FIEAM, Factories,WSC, etc.						
		Implement policy to strengthen coordination between A, G and WSCs	IPAAM, SUFRAMA, FIEAM, Factories, WSC, etc.						
D. Improve Business Environment for Waste Service Companies									
D.1	Make Manaus Municipal Landfill Fee-based	Make preparations to introduce fee at Manaus Municipal landfill	Municipality of Manaus						
		Make Manaus Municipal landfill fee-based	Municipality of Manaus, etc.						
D.2	Regulate Improper Waste Disposal	Inform and educate waste generators	IPAAM, SUFRAMA						
		Inform and educate waste service companies	IPAAM						
		Strict oversight of improper disposal by licensed/non-licensed WSCs	IPAAM						
D.3	Inform, Educate and Train Generators and WSCs	Strengthen IPAAM's IWM system	IPAAM						
		Formulate plan to inform, educate & train generators and WSCs	IPAAM						
		Implement plan to inform, educate & train generators and WSCs	IPAAM						
D.4	Cultivate Preferred Waste Service Companies	Study the good examples of advanced States	JICA Study Team, IPAAM						
		Formulate plan to cultivate preferred WSCs	IPAAM						
		Implement plan to cultivate preferred WSCs	IPAAM						



5.5.2 Project Evaluation

The following section is analysis of the results expected with the implementation of the Master Plan (M/P).

a. Expansion of the Market for Industrial Waste Treatment

At present, the majority of industrial waste generated at factories and businesses located in the "Industrial Pole of Manaus (PIM)" is disposed of in a landfill free of charge. Such conditions do not leave much room for industrial waste treatment /disposal businesses to be introduced.

According to the results of this study, it is estimated that industrial waste from 230,000 tons per year, or approximately 629 tons per day, of industrial waste are generated from PIM in 2009. The following table shows the present conditions of treatment and disposal of PIM industrial waste as estimated based on the factory survey results.

Table 5-32: Conditions of Treatment and Disposal of PIM Industrial Waste (2009)

Item	Non-HIW		HIW		All Industrial Waste	
	Amount (Ton/day)	%	Amount (Ton/day)	%	Amount (Ton/day)	%
Generation Amount	509.0	-	119.9	-	628.9	-
On-site Treatment and Disposal	22.2	4.4	4.2	3.5	26.4	4.2
Reuse/Recycle	6.4	1.3	2.5	2.1	8.9	1.4
On-site Storage	2.8	0.6	0.4	0.3	3.2	0.5
On-site Disposal	13.0	2.6	1.3	1.1	14.3	2.3
Off-site Treatment and Disposal	486.8	95.6	115.7	96.5	602.5	95.8
Reuse/Recycle by Contractor	200.2	39.3	20.0	16.7	220.2	35.0
Intermediate Treatment by Contractor	175.4	34.5	71.1	59.3	246.5	39.2
Direct disposal of at landfill	111.2	21.8	24.6	20.5	135.8	21.6

This table shows that at least 135.8 tons/day, or approximately 50,000 tons/year, accounting for some 21.6% of the industrial waste generated, is brought to the landfill untreated. Also, in addition to this, there is believed to be a significant amount of untreated waste or the residues from reuse /recycling and intermediate treatment contractors or other companies that end up in the landfill.

Moreover, assuming these conditions continue, the Master Plan formulated in this study estimates the following generation, treatment and disposal amounts for PIM industrial waste in the year 2015.

Table 5-33: Amount of PIM IW Generated, Treated and Disposed of in 2015

Item	Non-HIW		HIW		All Industrial Waste	
	Amount (ton/Day)	%	Amount (ton/Day)	%	Amount (ton/Day)	%
Generation Amount	628.2	-	157.5	-	785.7	-
On-site Treatment and Disposal	26.2	4.2	5.4	3.4	31.6	4.0
Reuse/Recycle	8.1	1.3	3.8	2.4	11.9	1.5
On-site Storage	2.9	0.5	0.4	0.3	3.3	0.4
On-site Disposal	15.2	2.4	1.2	0.8	16.4	2.1
Off-site Treatment and Disposal	602.0	95.8	152.1	96.6	754.1	96.0
Reuse/Recycle by Contractor	238.3	37.9	29.6	18.8	267.9	34.1
Intermediate Treatment by Contractor	227.8	36.3	94.5	60.0	322.3	41.0
Direct disposal of at landfill	135.9	21.6	28.0	17.8	163.9	20.9

Based on the results of future estimation, the amount of industrial waste taken to the landfill in 2015 will be approximately 163.9 ton/day, or about 60,000 ton/year.

Meanwhile, the M/P proposes that Non-HIW & Non-inert IW is no longer brought to the landfill for municipal waste. Also, it proposes that HIW is reduced or detoxified through intermediate treatment, such as co-processing, or through reuse /recycling and intermediate treatment, and the residues disposed of at Non-HIW & Non-inert IW landfill.

The M/P aims to build a system of appropriate regulation and management for IW treatment and disposal, as is currently implemented in advanced states such as Sao Paulo, and in addition to that, to cultivate waste service companies that will carry out appropriate treatment and disposal of industrial wastes.

With that, the following table is an estimate of the industrial waste final disposal market in PIM in 2015, based on the current final disposal fees (not including collection and transportation costs) for Non-HIW and HIW at the industrial waste landfill in Sao Paulo State (not including intermediate treatment).

Table 5-34: PIM 2015 Market Scale for IW Disposal

	Amount (ton/Day)	Annual Disposal (ton/Year)	Disposal Fee (Real/ton)	Total Market Size (Based on Fee) (Real/Year)
Non-HIW	135.9	49,603.5	100[*1]	4,960,350
HIW	28.0	10,220.0	250[*2]	2,555,000
Total Industrial Wastes	163.9	59,823.5	-	7,515,350

[*1] 100 Real/ton is the median disposal fee of 80 – 120 Real/ton charged for Non-HIW in Sao Paulo State.

[*2] 250 Real/ton is applied for the HIW disposal fee in Sao Paulo State.

The market scale for industrial waste disposal in the Industrial Pole of Manaus in 2015, based on fees, is estimated to be about 7.5 million Real per year.

Actually, it is also possible that part of industrial waste (e.g. Residues from treatment) currently contracted to reuse/recycling companies and intermediate treatment companies could be taken to the new landfill (which is 215,423 tons/year, about 3.6 times the 59,824 tons/year of landfill waste), if management and regulation for the proper treatment and disposal of industrial waste are strengthened, and companies conducting improper activities are eliminated through careful implementation of the M/P.

b. Expansion of Potential to Attract "High Value-Added Industry" and "Export Industry" to the Industrial Pole of Manaus through Appropriate Industrial Waste Management System and the Provision of Infrastructure for Treatment and Disposal

In order for the Industrial Pole of Manaus to be an important center of economical and industrial activity that supports the social and economic development of the Amazonas State, it must produce higher economic profits by providing industrial infrastructure that can attract "high value-added industries" such as high-tech/IT equipment, and form connections to the international market by attracting the "export industry".

The high value-added "high-tech/IT industry", symbolized by the semiconductor industry, uses a number of chemical substances and rare metals in its manufacturing process and produces wastes in the form of waste oil, solvents and sludge, which includes materials containing hazardous properties. Thus, there is the possibility that preparing the environmental infrastructure to properly treat and disposal of these types of wastes is an important condition in factory location for these high-tech industries.

The exporting industry, which targets the international market, particularly in industries targeting export to advanced countries in the OECD, contains strict environmental policy obligations based on bilateral free trade agreements, ISO14001 and so forth for the production and manufacturing processes, which includes the proper treatment and disposal of wastes. In these exporting industries, since locating a factory in a region that does not guarantee the proper treatment and disposal of industrial waste is a huge risk, it is a critical requirement for those who hope to attract these industries to prepare a proper waste management system and the infrastructure for treatment and disposal.

This point was considered in the M/P formulated in this study by promoting a proper industrial waste management system and provisions for treatment and disposal infrastructure in PIM. This will contribute to greatly increasing the potential to attract industry with greater economic profit.

c. Improvement of Production Efficiency through Waste Reduction Efforts (Efficiency of Resource and Energy Usage)

Implementing the M/P and reinforcing industrial waste management, waste generators, starting with factories, will have to bear an additional cost for the proper treatment and disposal of waste to act in accordance with standards prescribed in the regulations. In Manaus, where the current cost burden is zero, it may be possible to implement a burden of 100 – 250 Real per ton as currently charged in Sao Paulo City. To do so, it is likely that waste generators will have to be strongly motivated to reduce or minimize their wastes as much as possible.

However, reducing or minimizing wastes produces the merits of raising material and energy efficiency in the manufacturing process, improving production and reducing costs, so they may make the efforts to this effect. Furthermore, it is possible to establish a stable operation

foundation that can withstand price fluctuations in materials and energy, and changes in product demand.

As the M/P recommends, if the factories and businesses located in PIM are strongly motivated to control the generation of waste, this could lead to opportunities to increase factory production. In this regard, as was historically proven in Japan in the past, when the country's industries improved their production efficiency and reduced production costs, it was able to surpass the critical risk factors such as rising oil prices and currency appreciation.

As one of the BRIC emerging economies, Brazil is expected to lead the world's economic future and form a powerful industrial infrastructure based on resource and energy efficiency on par with the developed countries, which is essential to ensure sustainable future development.

6. Guidelines to Improve Industrial Waste Management in PIM

6 Guidelines to Improve Industrial Waste Management in PIM

6.1 Guideline Objectives and Composition

6.1.1 Guideline Objectives

The aim of the guidelines is to support the Master Plan objective to "establish an appropriate industrial waste management system in the Industrial Pole of Manaus (PIM)". To achieve this objective, the guidelines shall serve to achieve the following three requirements.

1. To establish an appropriate management system at generation sources (such as factories) for dischargers of industrial waste.
2. To establish an appropriate management system for industrial waste that has been discharged for waste service companies.
3. To establish the administrative system for industrial waste management to promote, guide, monitor and regulate proper management for dischargers of industrial waste and waste service companies.

6.1.2 Composition of the Guidelines

The following three items in the Master Plan (see previous chapter) shall be used to the greatest extent possible as tools to achieve the objectives of the above-mentioned guidelines.

1. Waste inventory (WI) management system
2. Waste service company licensing and registration management system
3. Waste manifest system

These guidelines are meant to promote the improvement of industrial waste management through the effective use of these tools by waste dischargers, waste service companies (WSC) and administration. The guidelines are composed as shown below:

1. Items common to the three tools
2. Guidelines for waste dischargers
3. Guidelines for WSCs
4. Guidelines for administrative entities

These guidelines were formulated for the PIM factories that discharge industrial waste in the target study area, the waste service companies (WSCs) which handle the discharged waste, and the administration that handles overall industrial waste management. However, they were created as much as possible so that they may serve as reference material for other industrial complexes or areas where factories are concentrated. Accordingly, stakeholder organizations such as SUFRAMA or the Ministry of Environment, are expected to share these results with related organizations, such as industrial groups and so forth, nationwide.

6.2 Common Items

The key in putting the three systems--for waste inventory (WI) management, WSC registration management, and waste manifest--to use is that each of these systems uses common code and units of measurement. This section discusses the importance of each system utilize these common items.

6.2.1 Waste Definition and Categorization of Wastes and How to Determine Them

In each of the three systems, industrial waste is divided into three major categories, based on CONAMA Resolution 313.

- General industrial waste
- Health-care waste
- Construction waste

How each of the wastes are defined and categorized, as well as the methods to determine these ends, is discussed below.

a. General industrial waste

General industrial waste is defined as all waste generated in a factory, including administrative and production units, but excluding health-care waste and construction waste (see below). This category will use both the waste category set forth in CONAMA Resolution 314 (hereafter, CONAMA code) and the waste code created by JICA Study Team through the discussion and approval with IPAAM/SUFRAMA (hereafter, JICA Study code).

The conventional CONAMA code categorizes wastes in great detail based on the chemical composition and physical properties. However, the code is overly detailed for practical application, particularly for IPAAM/SUFRAMA to manage waste based on the actual industrial waste management flow. In order to identify the general industrial waste flow according to the waste the JICA Study Team set up the Study code that has 29 categories, with 13 types of Non-HIW, and 16 types of HIW and identify the industrial waste flows of 29 categories of general IWs. In addition the JICA Study Team has prepared a chart comparing both CONAMA and JICA codes so that it will be easy to enter the waste code.

The wastes categories are shown in the table below.

Table 6-1: Non-Hazardous General Industrial Waste Categories used in the Study

Type of Non-HIW	Non-HIW Code
Kitchen waste (include waste from animal such as bone, skin, hair)	NH01
Wood	NH02
Paper	NH03
Plastic or polymers and resins	NH04
Textile and fiber	NH05
Animal oil, Vegetable oil	NH06
Rubbers and Leather	NH07
Ash/dust from coal-fired power plants, etc.	NH08
Metals and metal alloys such as aluminum, copper, bronze	NH09
Ceramic & Glasses	NH10
Stone, sand or material that have composition of soil such as tile, brick, gypsum, cement	NH11

Mixed waste (This code shall be applied in case wastes are discharged without separation.)	NH12
Others	NH13

Source: JICA Study Team

Table 6-2: Hazardous General Industrial Waste Categories used in the Study

Type of HIW	HIW Code	Example of HIW
Inorganic acid	HW01	Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl), Nitric acid (HNO_3), Phosphoric acid (H_3PO_4), Other inorganic acids
Organic acid	HW02	Acetic acid (CH_3COOH), Formic acid (HCOOH), Other organic acids
Alkalis	HW03	Caustic soda (NaOH), Ammonia (NH_3), Sodium carbonate (Na_2CO_3), Other alkaline materials
Toxic Compounds	HW04	including Hg, As, Cd, Pb, Cr, CN
Inorganic Compounds	HW05	Plating wastes, Picking waste, Sulphides, etc.
Other Inorganic	HW06	Asbestos, Slug, etc.
Organic Compounds	HW07	Reactive chemical wastes (Oxidizing agents, Reducing agents, etc), Solvents etc.
Polymeric Materials	HW08	Epoxy resin, Chelate resin, Polyurethan resin, Latex rubber etc.
Fuel, Oil and Grease	HW09	Fats, Waxes, Kerosene, Lubricating oil, Engine oil, Grease etc
Fine Chemicals and Biocides	HW10	Pesticides, Medicine, Cosmetic, Drugs, etc.
Treatment Sludge	HW11	Inorganic sludge, Organic sludge, Septic tank sludge, etc.
Ash from incinerator	HW12	---
Dust and Air pollution control (APC) products	HW13	Soot and dust waste from incineration facilities, treating exhaust gas
Other Hazardous substance (besides HW01-HW13)	HW14	HIWs other than the above
Mixed Waste	HW15	---
Hazardous materials from Non-production process	HW16	Fluorescent tubes, Thermometer (use mercury), Batteries, Pesticides (Household use), etc.

Source: JICA Study Team

b. Health-care Waste

Health-care waste is defined as waste generated from clinics attached to factories. This category uses the groups set forth in ROC 306/2004-ANVISA. It is not necessary for factories that do not have attached clinics to answer this section.

The health-care waste category is shown in the table below.

Table 6-3: Conversion of Health-care Waste Categories between RDC 306/2004-ANVISA and ABNT NBR 12809

RDC 306/2004-ANVISA			**ABNT NBR 12809**	
Group		Description	Class, Type	Description
1. Group A	A.1	Biologic	Class A, Type A.1	Biologic
			Class A, Type A.2	Blood and Derivates
	A.2	Animals	Class A, Type A.5	Contaminated animal
	A.3	Body part	Class A, Type A.3	Surgical, anatomopatologic and exudates
	A.4	Patient care etc.	Class A, Type A.6	Patient care
	A.5	Prions	Not applicable	---
2. Group B		Chemical etc.	Class B, Type B.2	Pharmaceutical waste
			Class B, Type B.3	Hazardous chemical waste
3. Group C		Radioactive waste	Class B, Type B.1	Radioactive waste
4. Group D		Common waste	Class C	Common waste
5. Group E		Piercing or Cutting	Class A, Type A.4	Piercing or Cutting

c. Construction Waste

Construction waste is defined as waste that was generated from construction at factories (from all departments, including administration and production) in the past one year. This code utilizes the classes set forth in CONAMA Resolution 307.

The Construction wastes category is shown in the table below.

Table 6-4: Construction Waste Categories in CONAMA Resolution 307

Class	Description
Class A:	The reusable or recyclable waste as aggregates, such as:
	a) from construction, demolition, refitting and repair of pavement and other infrastructure constructions, including land preparation;
	b) from the construction, demolition refitting and repair of edifications: ceramic components (bricks, blocks, tiles, insulation planks, etc.), cement and concrete;
	c) from manufacturing and/or demolition process of concrete pre-modulated pieces (blocks, pipes, gutter, etc.) produced in the construction sites.
Class B	The recyclable waste for other purposes, such as: plastics, paper/carton, metals, glass, wood and others.
Class C	Waste which has no economically feasible technology or applications which may allow it to be recycled/recovered, such as the products arisen from plaster.
Class D	Hazardous waste arisen from construction process, such as paints, solvents, oils and so forth, or those contaminated or harmful to health arisen from demolitions, refitting and repairs of radiology clinics, industrial facilities and others, as well as tiles and other objects and materials containing asbestos or other products harmful to health. *(new text given by Resolution n. 348/04)*.

6.2.2 Non-IW Common Items

a. Factory Categorization Code

The factory categories utilize the categorization SUFRAMA uses for registered factories.

SUFRAMA uses 19 factory codes, and further subdivides 4 of the factory codes for a total of 28. However, only the large factories included in Part 1 of the SUFRAMA factory list use the sub-categories, so only the 19 primary categories are used for industrial waste management, such as when creating the waste flowcharts.

The Factory categorization code has been attached at the front of this report for the reader's reference.

b. Waste Service Company Categorization Code

IPAAM plans to use a new environmental license code dedicated only for waste service companies (WSC). There are two main categories depending on the type of waste the WSC handles: "Municipal Waste (code 33xx)" and "Industrial Waste (code 34xx)", which are then subdivided into categories for collection/transportation, intermediate treatment, reuse/recycling, and final disposal. These codes are given in the table below.

If a company conducts more than one type of service, it must be licensed and registered under all of the appropriate codes. For example, if a company collects and transports industrial waste and also recycles it, then it will have to be registered under both code 3401 and 3403.

Table 6-5: Waste Service Company Categorization Codes (Draft)

Code	Major Classification	Code	Sub-classification	Class [types of Waste Handled]
33	Municipal Waste Management	3301	Collection and Transportation	A(HW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3302	Intermediate treatment	A(HW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3303	Reuse/Recycling	B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3304	Final disposal	B(Non-HW & Non-Inert), C(Non-HW & Inert)
34	Industrial Waste Management	3401	Collection and Transportation	A(HIW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3402	Intermediate treatment	A(HIW),B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3403	Reuse/Recycling	B(Non-HW & Non-Inert), C(Non-HW & Inert)
		3404	Final disposal	B(Non-HW & Non-Inert), C(Non-HW & Inert)

c. Units of Measurement

The amount of general industrial waste, health-care waste and construction waste generated in PIM is indicated in weight (tons) as a unit of measurement, which also served to create the PIM waste flow. Waste generated by volume or individually is to be converted to indicate

weight before being entered. Also, in cases where the generation amount is extremely small, such as for health-care waste, it can be indicated in kilograms (kg) instead of tons.

(Note: measure by apparent density as a simple conversion method from volume (m^3) to weight (ton))

(1) Things to prepare

- Sample (when weight is unknown)
- Plastic bucket (about 20 litres)
- Scale (max. approx. 50kg)

(2) Measure the weight of the plastic bucket (Basket weight (Bw): kg)

(3) Measure the weight of the plastic bucket with 10 liters of water (the water ratio is 1.0 so this is 10kg).

(4) Mark the water line of 10 liters of water in the bucket.

(5) Pour out the water and pack the sample into the bucket up to the line. (Gwb (kg) = Bw + Weight of 10 liter sample)

(6) The sample's apparent density AM (ton/m^3) is calculated with the following formula.

$$AM\ (ton\ /\ m3) = \frac{(Gwb\ -\ Bw)}{10}$$

(7) Sample weight conversion: Multiply the known volume of the sample by AM and calculate the weight.

d. Other

The databases for the waste inventory management system (WI_DB), waste service company licensing and registry management system (WSC_DB), and waste manifest system (WMS) are all managed using the National Corporate Tax Payer registration number (CNPJ) as their "Primary key" so that all the databases can be linked. Consequently, the format of the CNPJ to be entered will be the officially registered CNPJ. If this is done online, a program will confirm the number entered according to the following format.

CNPJ Format: XX.XXX.XXX/0001-1

6.3 Waste Management Improvement Guidelines for Waste Dischargers (Factories)

6.3.1 Requirements for Making the Waste Inventory

a. Waste Flow

Understanding the waste flow is important in order to conduct appropriate industrial waste management. The waste flow is made up of waste management (treatment /disposal) at the generation source (on-site) and waste management (treatment /disposal) by WSCs (off-site). A conceptual diagram of this waste flow is shown in the figure below.

This study attempted to gauge the waste flow in all of PIM by conducting a factory survey for on-site management (treatment /disposal), and a survey of WSCs for off-site management (treatment /disposal). These results were analyzed and the outcome was used to make an

overview of the waste flow. However, information concerning waste discharged from factories varied and some WSCs were unaware of the accurate figures, so there was some ambiguity in the flow between on-site and off-site.

Information about to whom the waste was discharged and how it would be treated and disposed is to be included on the waste inventory, but there is no uniform standard between companies; with only one person in SUFRAMA managing the waste inventories, it is not possible to aggregate the information.

IPAAM/SUFRAMA has created a standard waste inventory which will be filled out in a uniform manner, which will then be integrated into a database. By doing so, it will be possible to make effective use of this information to manage industrial waste in the future.

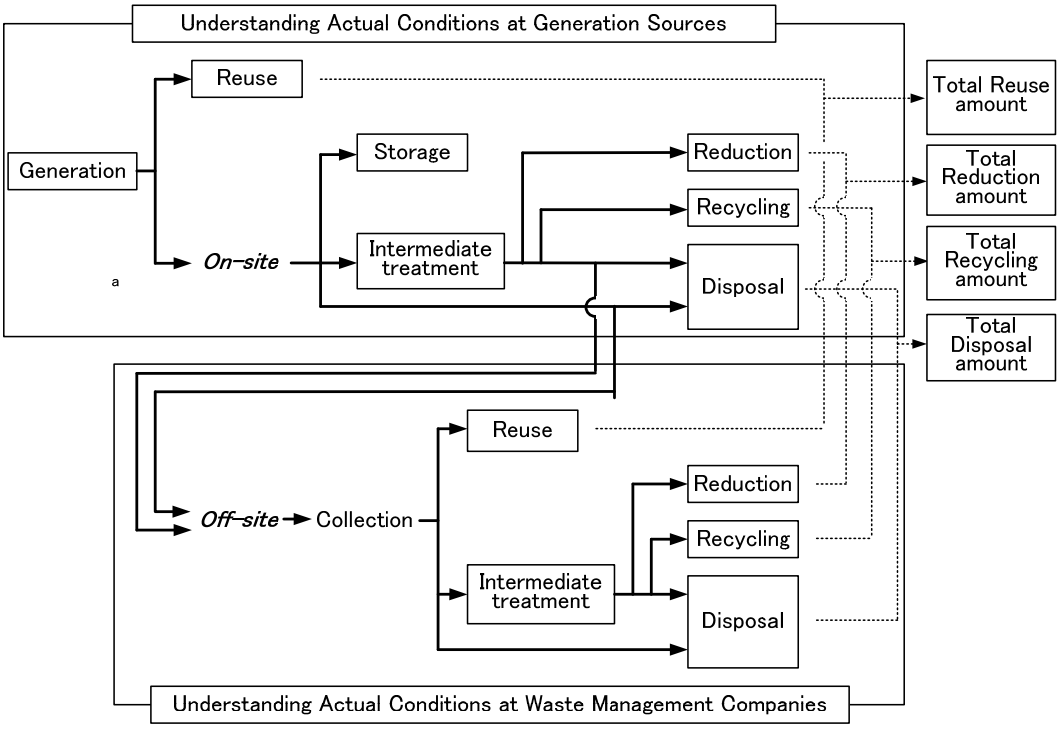


Figure 6-1: Flow of Waste Treatment and Disposal

b. Summary of On-site Waste Management

CONAMA Resolution 313 calls for highly detailed factory information to be included on the waste inventory. The CONAMA Resolution 313 scheme is shown in the following figure.

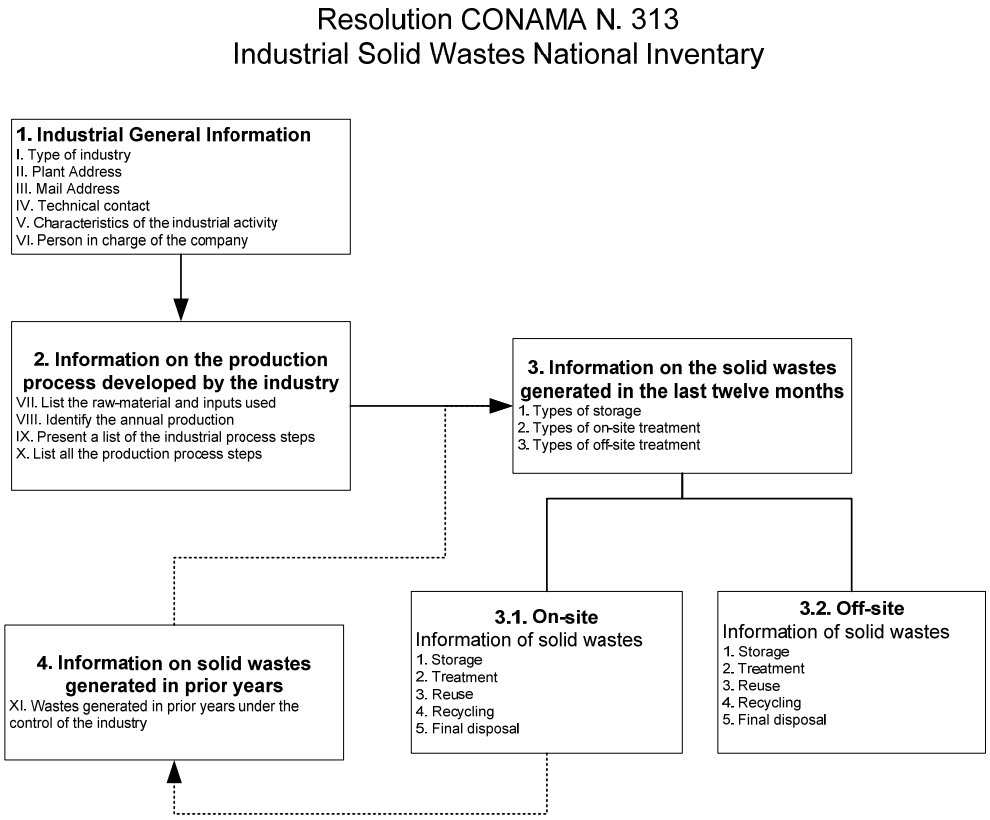


Figure 6-2: Scheme of the Information required by CONAMA resolution 313

It is possible to gauge the overall on-site management of waste by aggregating and analyzing this waste inventory information. However, because only 1/4 of factories submit the WI and the variation in the manner in which those received are filled out, there is no way at present to easily aggregate and make use of the data.

This guideline provides detailed instructions to filling out the information necessary for the WI and makes it possible for the factories to report using a single format. The detailed instructions called for in CONAMA Resolution 313 are given in the Chapter 5.2.1 of the Supporting report.

c. Summary of Off-site Waste Management

The waste inventory also requires off-site treatment and disposal to be reported. However, the number of WSCs and what activities they are engaged in are uncear, so this can not be accurately filled in. This guideline also provides information on the database for waste service companies (WSC_DB), which will be made separately from WI_DB. By using this database, those discharging waste (factories) will be able to obtain accurate information on WSCs. Using both of these databases, it will be possible to obtain highly reliable information on off-site treatment and disposal.

d. Summary of the Waste Inventory Database

Once factories use the same format to submit the waste inventory, and these are put into a database, it will be possible to easily aggregate and analyze the data.

SUFRAMA will organize a new IWM group to assist factories and manage the WI database.

Once a factory creates its WI for the WI_DB, form next year it will only need to update some information such as amount of raw materials used and waste amounts generated, etc. The WI submitted in the year 2008 (IWM data for 2007) has already been entered into the WI_DB. In addition, the factory survey data conducted in 2009 (IWM data for 2008) also has been input into the database.

The general scheme of the WB_DB is shown in the figure below.

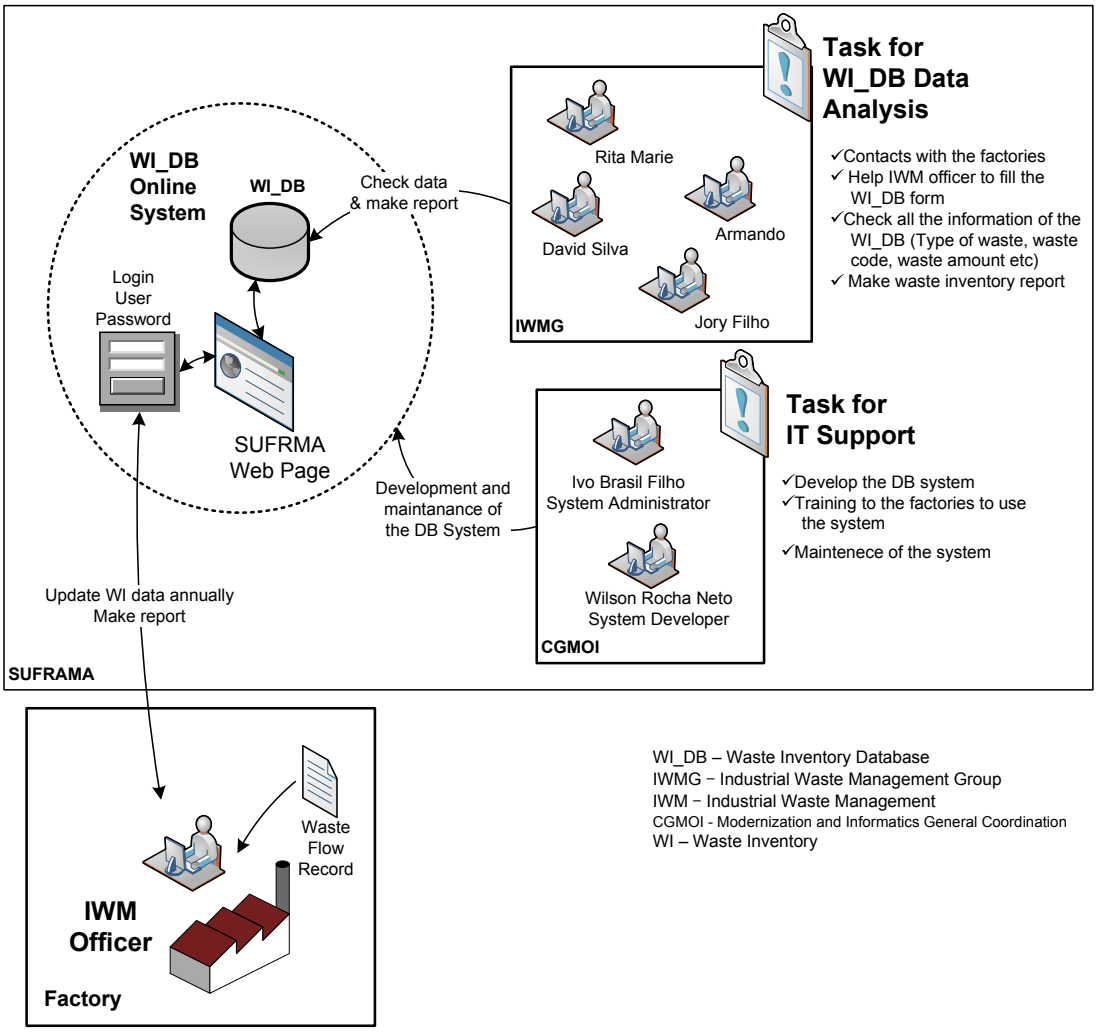


Figure 6-3: General Scheme for Implementation of the WI_DB

6.3.2 Requirements for Preparation of Waste Manifest

The waste manifest system was not provided in the study in a concrete format, unlike the waste inventory (WI) management system and waste service company registry management system. However, in the study, it was proposed that IPAAM quickly prepare this system in cooperation with advanced states, such as Rio de Janeiro. Subsequently, the requirements to create the waste manifest system were prepared as shown below, based on the assumption that IPAAM would introduce the method used in Rio de Janeiro.

a. General Information

The waste manifest (WM) is the basic document used to facilitate the waste manifest system. The WM provides information about the wastes and their origin, transport, and destination, and establishes joint responsibility between the generator, transporter and receptor, including final destination of the waste. The diagram below visualizes the concept of the proposed waste manifest system.

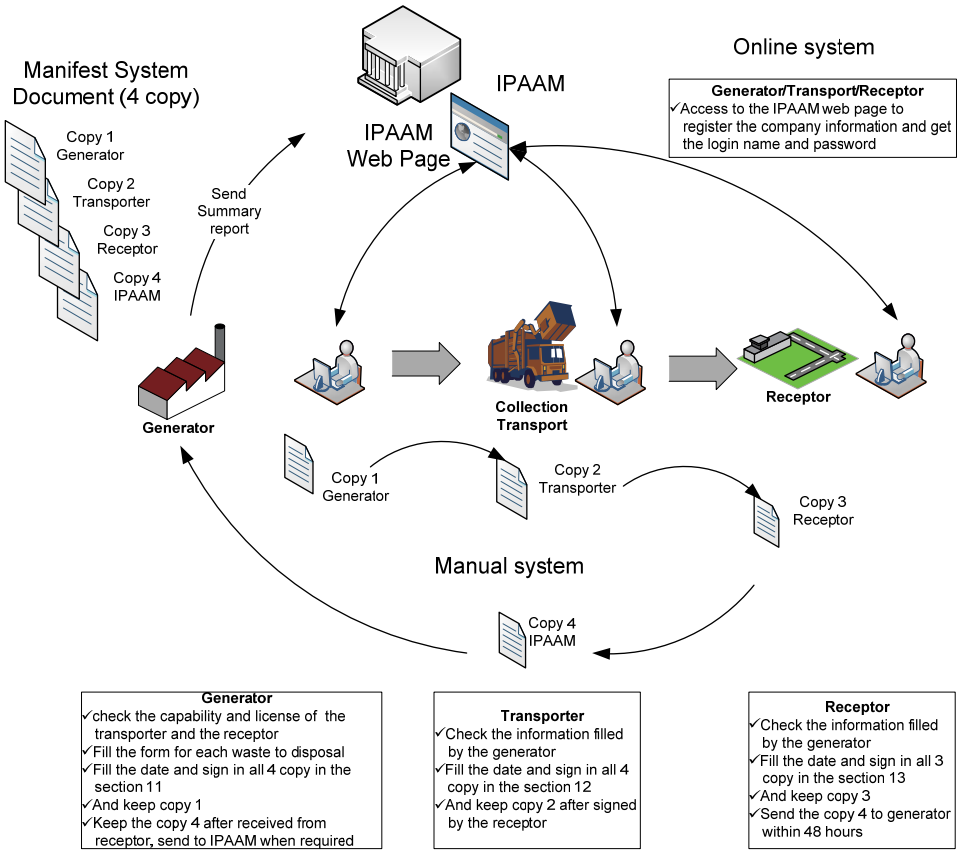


Figure 6-4: Concept of the Proposed Waste Manifest system

The waste manifest (WM) is issued in four copies by the waste generator, who keeps one and sends the others to the transporter together with the waste. The transporter keeps one copy of the WM and delivers the waste and remaining two copies to the waste receptor. Finally, the receptor receives the waste, keeps one copy of the WM and returns the last one back to the generator, completing the cycle. IPAAM will indicate which sheet will remain with each respective party.

Although the generator issues the original WM, a manager will be contracted to oversee the service. The WM should be issued specifically for each type of waste, even when several types are transported in a same load or when several loads of the same waste are transported together. Furthermore, even when several loads are transported by the same transporter or delivered to the same receptor, each load should be accompanied by a specific WM.

IPAAM will designate a unique serial number for each set of the waste manifest (4 copies) which also identifies the waste generator. This is to prevent fraud, such as any deviation from the required protocol.

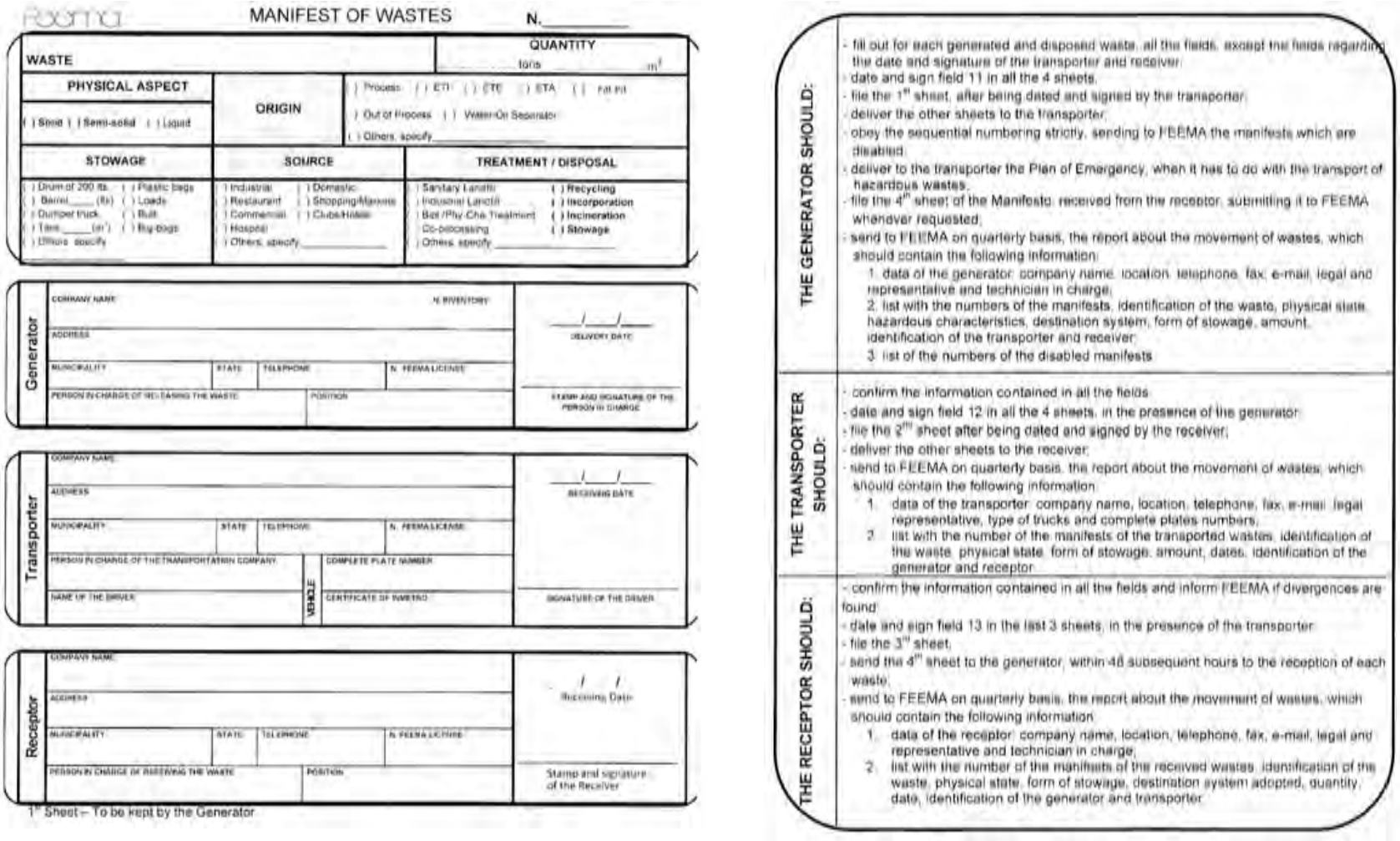
All generators, transporters and receptors, public or private, in the waste manifest system will be linked to the IPAAM web page. Since the generator may receive the 4th copy of the WM,

and as such, will be show up twice, IPAAM will need to define the relationship of the four (4) copies each time to avoid confusion.

The protocol of transferring and receiving the wastes within the waste manifest system is established specifically in each case at the discretion of IPAAM depending on the hazard and the amount of wastes generated by a factory's activities. General and public solid wastes are usually excluded, so the system is applied to the industrial plants' systems and their health services as well as the owners of construction sites, but excludes the domestic waste generated in those plants.

IPAAM will supply the generator with instructions, together with the serial number, and the forms or a model to make the forms.

The waste manifest form used in Rio de Janeiro is shown in the following figure.



MANIFEST OF WASTES N._____

WASTE | QUANTITY tons ____ m³

PHYSICAL ASPECT: ( ) Solid ( ) Semi-solid ( ) Liquid

ORIGIN: ( ) Process ( ) ETI ( ) ETE ( ) ETA ( ) Fat Pit ( ) Out of Process ( ) Water-Oil Separator ( ) Others, specify_____

STOWAGE: ( ) Drum of 200 lts. ( ) Plastic bags ( ) Barrel____(lts) ( ) Loads ( ) Dumper truck ( ) Bulk ( ) Tank_____(m³) ( ) Big-bags ( ) Others, specify_____

SOURCE: ( ) Industrial ( ) Domestic ( ) Restaurant ( ) Shopping/Markets ( ) Commercial ( ) Clubs/Hotels ( ) Hospital ( ) Others, specify_____

TREATMENT / DISPOSAL: ( ) Sanitary Landfill ( ) Recycling ( ) Industrial Landfill ( ) Incorporation ( ) Bio/Phy-Che Treatment ( ) Incineration ( ) Co-processing ( ) Stowage ( ) Others, specify_____

Generator: COMPANY NAME; N. INVENTORY; ADDRESS; MUNICIPALITY; STATE; TELEPHONE; N. FEEMA LICENSE; PERSON IN CHARGE OF RELEASING THE WASTE; POSITION; ___/___/___ DELIVERY DATE; STAMP AND SIGNATURE OF THE PERSON IN CHARGE

Transporter: COMPANY NAME; ADDRESS; MUNICIPALITY; STATE; TELEPHONE; N. FEEMA LICENSE; PERSON IN CHARGE OF THE TRANSPORTATION COMPANY; VEHICLE; COMPLETE PLATE NUMBER; NAME OF THE DRIVER; CERTIFICATE OF INMETRO; ___/___/___ RECEIVING DATE; SIGNATURE OF THE DRIVER

Receptor: COMPANY NAME; ADDRESS; MUNICIPALITY; STATE; TELEPHONE; N. FEEMA LICENSE; PERSON IN CHARGE OF RECEIVING THE WASTE; POSITION; / / Receiving Date; Stamp and signature of the Receiver

1st Sheet – To be kept by the Generator

THE GENERATOR SHOULD:
- fill out for each generated and disposed waste, all the fields, except the fields regarding the date and signature of the transporter and receiver;
- date and sign field 11 in all the 4 sheets;
- file the 1st sheet, after being dated and signed by the transporter;
- deliver the other sheets to the transporter;
- obey the sequential numbering strictly, sending to FEEMA the manifests which are disabled;
- deliver to the transporter the Plan of Emergency, when it has to do with the transport of hazardous wastes;
- file the 4th sheet of the Manifesto, received from the receptor, submitting it to FEEMA whenever requested;
- send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information:
  1. data of the generator: company name, location, telephone, fax, e-mail, legal and representative and technician in charge;
  2. list with the numbers of the manifests, identification of the waste, physical state, hazardous characteristics, destination system, form of stowage, amount, identification of the transporter and receiver;
  3. list of the numbers of the disabled manifests.

THE TRANSPORTER SHOULD:
- confirm the information contained in all the fields;
- date and sign field 12 in all the 4 sheets, in the presence of the generator;
- file the 2nd sheet after being dated and signed by the receiver;
- deliver the other sheets to the receiver;
- send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information:
  1. data of the transporter: company name, location, telephone, fax, e-mail, legal representative, type of trucks and complete plates numbers;
  2. list with the number of the manifests of the transported wastes, identification of the waste, physical state, form of stowage, amount, dates, identification of the generator and receptor.

THE RECEPTOR SHOULD:
- confirm the information contained in all the fields and inform FEEMA if divergences are found;
- date and sign field 13 in the last 3 sheets, in the presence of the transporter;
- file the 3rd sheet;
- send the 4th sheet to the generator, within 48 subsequent hours to the reception of each waste;
- send to FEEMA on quarterly basis, the report about the movement of wastes, which should contain the following information:
  1. data of the receptor: company name, location, telephone, fax, e-mail, legal and representative and technician in charge;
  2. list with the number of the manifests of the received wastes, identification of the waste, physical state, form of stowage, destination system adopted, quantity, date, identification of the generator and transporter.

Figure 6-5: Waste Manifest Form (FEEMA - Rio de Janeiro)

b. Procedures of the Generator

To consciously take his responsibilities, the Generator should:

- Nominate the Wastes Manager of his company, whose attributions will include, without restricting, the internal implementation of the Waste Manifest System, with the due instructions and trainings, and the relationship with IPAAM concerning everything about that System.
- Make sure the Transporter and the Receptor are granted with the Operation License from IPAAM, and that their equipments and facilities are perfectly qualified to render the service.
- Issue manifests for each waste and cargo, filling out all the fields in the four sections of the form, except the fields regarding to date, signature and stamp of the Transporter and Receptor.
- Write the date, sign and stamp the four sheets, in the field reserved to the Generator.
- File his sheet, after it has been dated, signed and stamped by the Transporter, to whom the other sheets will be handed in.
- Strictly follow the sequential numbering provided by IPAAM, filing the unused sheets and informing the fact to IPAAM, if requested.
- Take into account the due signaling of the transportation vehicle, and provide the Transporter with the Emergency Plan[1], in the case of hazardous wastes.
- Keep the sheet received from the Receptor for 5 years, presenting or providing IPAAM with a copy whenever requested.
- Provide IPAAM with the Wastes Flow Report on monthly basis, which will synthesize all the used and unused WM.

c. Infraction and Penalties

The non-fulfillment of the legal regulation (to be) established by IPAAM is regarded as infraction subject to the penalties set therein.

d. Completion of the Wastes Manifest

The WM is formed by 4 (four) sheets, filled out by the Generator and completed, successively, by the Transporter and the Receptor, under the previously mentioned step.

The form comprehends 4 (four) sections, with the following content:

1st Section: basic information on the waste, its generating source and destination.

2nd Section: information about the Generator and its responsibilities.

3rd Section: information about the Transporter its responsibilities.

4th Section: information about the Receptor and its responsibilities.

[1] The EMERGENCY PLAN is the plan which defines the actions to be carried out in case of fire, explosion, spilling, or emission of poisonous gases, describing the safety equipments to be used and identifying the people responsible for the coordination and participation in the emergency actions, and how to get in touch with these people.

The completion of the WM form will be as simple as the project of that form, to be done by IPAAM. The model used by INEA (former FEEMA), in the State of Rio de Janeiro, is simple and self-explanatory, for that it is presented in the Figure 6-5, as an example.

The form comprehends 4 sections and 13 fields to be filled out: The first section informs on the waste: name or sufficient identification, amount, physical state, unit, packaging, origin (plant), treatment, recycling or final disposal.

The **second section** informs on the Generator: company, address, municipality, telephone and the number of the license (OL) supplied by IPAAM; it is completed with the name of the person responsible for the outgoing and his position; the last field has the date of the delivery to the Transporter and the signature and stamp of the person in charge.

The **third section** informs on the Transporter: company, address, municipality, telephone and the number of the license (OL) supplied by IPAAM; name of the person responsible for the company and the driver, number of the plate and the certificate of INMETRO (Metrological Instruction), for the vehicle; it is completed with the signature, stamp and date of the reception of the cargo, thus taking co-responsibility for the waste flow.

The **fourth section** informs on the Receiver: the data of the company mentioned above, plus the name of the person responsible for the reception of the waste and his position; the last field presents the date of the reception, signature and stamp of the person responsible for the reception, thus taking co-responsibility for the waste flow.

e. Waste Electronic Manifest

As soon as IPAAM is qualified, it will provide the members of the Waste Manifest System - Generators, Transporters and licensed Receivers with an OL – with the option of filling out the form on-line, in its own webpage.

The access will be granted through the registration of the member in that new modality, he will receive a password from IPAAM, and his login will be the number of his registration in CNPJ/MF. The registration can be done by electronic mail, finding out the data of the company: CNPJ/MF, company name, business name, complete address, phone number, fax number, number of the license (OL) of IPAAM, the legal representative's name and the name of the technician in charge.

The completion of the WM will be done with the same information needed for the paper form, but in a faster way.

6.3.3 Good Examples of Industrial Waste Management at Generation Sources (Factories)

Since the 1990s, many factories in Japan have been aiming for “Zero Emission” from their factories due to the following reasons:

- Since the off-site disposal cost is extremely expensive--especially the landfill disposal fee--they shall reduce, reuse and recycle waste in the factory as much as possible to reduce the cost of IWM.
- The Japanese Government set up a waste management policy, “Recycling-based Society ”, through the Basic Law for Establishing the Recycling-based Society (enacted in 2000); and
- Recently, consumers tend to support companies they consider to be environmentally friendly.

"Zero Emission" is the concept that there is "zero" waste going to the landfill from a factory. The Manaus municipal landfill takes waste at no charge so it is unlikely that most PIM factories would enact waste management in the way that Japanese factories have. Nevertheless, if the Manaus landfill becomes fee-based as proposed in the Master Plan and things proceed similar to other Brazilian States, it should be possible for factories in PIM to work toward a similar situation as Japanese factories in the near future. As such, five counterpart personnel received training in Japan from the end of January to early February 2010, receiving training on efforts at the following two places.

- Kokubo Industrial Estate
- Honda Suzuka Factory

a. Kokubo Industrial Estate

The Kokubo Industrial Estate is a 958,400 square meter area established in 1975 which now has 28 factories (as of April 2009), and 5,041 employees. The total production value in 2008 was 363.7 billion yen. Kokubo Industrial Estate is located inland, away from the ocean, in Yamanashi Prefecture, and a problem with the landfill was revealed in early 1990. As a result, all 28 companies began working together so that the industrial estate generated zero landfill waste.

A diagram of their activities to do so is shown below.

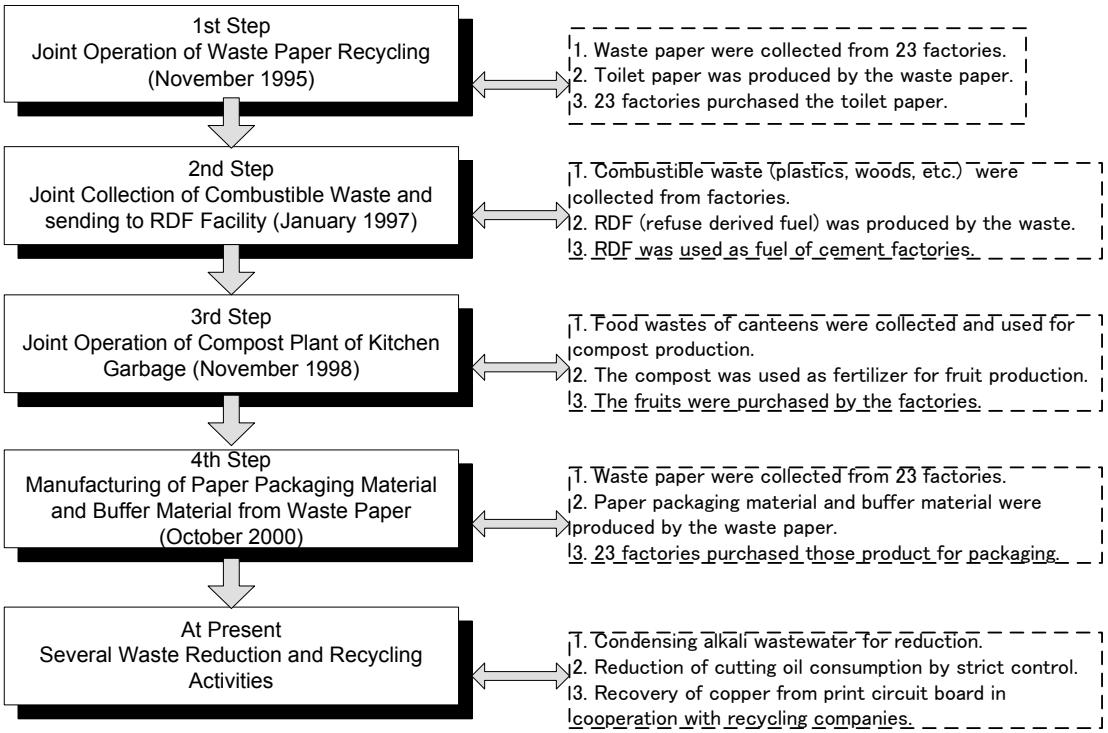


Figure 6-6: Kokubo Industrial Estate efforts for Zero Emission

b. Honda Suzuka Factory

Honda Suzuka Factory is one of the factories that achieved Zero-emission. Zero-emission is one of targets of the "Green Factory Plan" presented in the following figure. A Zero-emission team was created in the "Green Factory Project" in 1997. Zero-emission is defined as "No IWM for final disposal shall be discharged outside the factory". In 1999, Honda Suzuka Factory became the first zero-emission automobile manufacturing company in Japan.

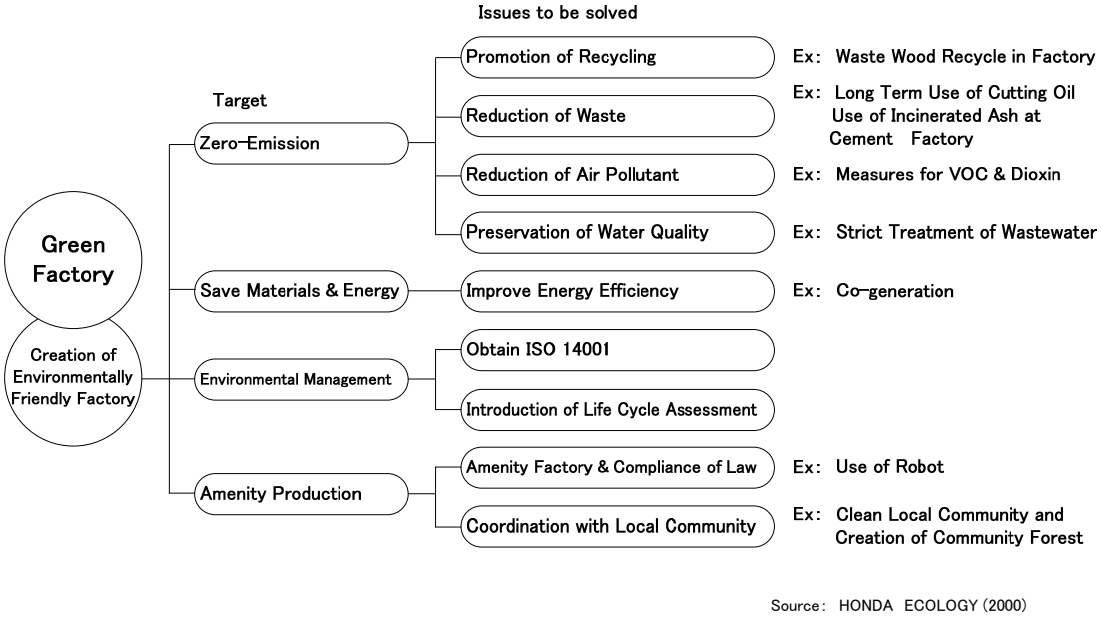


Figure 6-7: Green Factory Project of Honda Suzuka Factory

6.4 Guidelines for WSCs to Improve Waste Management

6.4.1 Requirement for Application of Operation Licence

a. Necessary Conditions for Database

The waste service company database is essential for appropriate industrial waste management in PIM. The database is categorized based on the new WSC licensing code, which makes it possible for IPAAM and waste dischargers (factories) to easily confirm the activities of the companies and select a company with which to contract according to the code.

Waste service companies are registered in the database according to code for the waste they handle, and further sub-categorized based on their activities (collection/transportation, intermediate treatment, reuse/recycle, final disposal). Accordingly, the application form will also call for these activities to be filled in.

IPAAM will manage the companies' applications into a database of waste service companies (WSC_DB). Furthermore, the WSC_DB will be made available online so that waste dischargers, such as factories, will be able to access and view the information using a password.

The application for WSCs conducting collection and transportation is shown below. The forms for other activities are given in the Supporting Report.

Table 6-6: Application Form for Collection and Transportation Activities

OPERATION LICENSE
TRANSPORT

1. General Information					
Company / Interested party:					
CNPJ / CPF:		**State Registration Number (SEFAZ-AM):**			
Mail address:					
District:	**Municipality:**		**ZIP:**		
Phone:		**Fax:**			
E-mail:					
Representative:		**Title:**			
Employee number:	Administration		Operation and Maintenance		
Area	Total (m2)		Plant (m2)		

2. TYPE OF LICENSE					
Type:	( ) Operation License – OL / ( ) Renewal:				
IPAAM Registration n.:		**Process N.**		**License Code**	
Business					
Starting date:		**Expiration date:**		**Validity of the license:**	
Polluting/Degrading Potential			**Size:**		
This license has restrictions:					
Location:					
Geographic Coordinates:	**Latitude:**		**Longitude:**		
Name of the Representative					
Phone:					
Name of the Technical Management Assessor (IPAAM):					
Name of the President Director (IPAAM):					

3. Type of Transport License Waste	
A	Transportation of non-hazardous industrial wastes

4. List of restrictions and/or conditions for the validity of this license
1. Restrictions 1 2. Restrictions 2 3. Restrictions 3 etc.

4. Transportation vehicel list					
N.	**Plate**	**Brand**	**Model**	**Load capacity**	**Obs. (Picture)**
1					
2					
3					

b. Necessary Conditions for Approval through checking

It will be necessary for IPAAM to confirm that the information received from WSCs on their application form is filled in correctly. If there is an error, IPAAM will have to indicate this and instruct the applicant to correct the mistake.

An application will be need to be accepted for each activity. The requirements for license approval are given in the Supporting Report.

The table below gives some simple definitions for the activities which WSCs will submit applications.

Table 6-7: Types of Activities and Definitions for WSCs Licensing Application

Types of Activity	Definitions
Collection and Transportation	This indicates the collection of waste from the place it is generated and transporting it to a designated place. The designated place will be an intermediate treatment facility, reuse/recycling facility or final disposal site (landfill). However, this does not cover temporary storage at a place owned by the collection/transportation company.
Intermediate treatment	This indicates waste treatment through a process such as incineration. Residues leftover from this process will be recycled or taken for final disposal site.
Reuse /Recycle	This indicates recovery of valuable materials (paper, metal, PET-plastic, etc.) through the treatment of waste. This also includes production of products by using wastes as raw materials through some kind of process. The co-processing, such as when all waste is used as fuel or manufacturing raw materials at a cement factory, which does not produce residue, is also considered as recycling, although the co-processing is considered as the final destination of waste.
Final disposal	This is the final acceptance of waste and a final disposal site such as landfill.

A technical standard for the application of each licensing activity will be established by IPAAM for the facilities used for each of these activities. A general technical standard in regards to the four activities is proposed by the JICA Study Team in the Supporting Report. This technical standard will need to be duly reviewed within IPAAM to prepare regulation for a final draft of the technical standard.

6.4.2 Requirements for the Issuance of the Waste Manifest (WM)

The WSCs (Transporter or Receptor) shall follow the sub-items “General Information” and “Infractions and Penalties” and “waste Electronic Manifest” presented in item 6.3.2 as requirements for the issuance of the waste manifest (WM).

a. Procedures of the Receptor -

To consciously take his responsibilities, the WSCs (Transporter or Receptor) should:

- Nominate the Wastes Manager of his company, whose attributions will include, without restricting, the internal implementation of the Waste Manifest System, with the due instructions and trainings, and the relationship with IPAAM concerning everything about that System.

- Confirm the transporter have signed the three sheets of the WM.
- Write the date, sign and stamp the three sheets, in the field reserved to the Receptor.
- File his sheet and keep it for five years; and return the other sheet to the Generator within two days after the reception of the waste.
- Provide IPAAM with the Wastes Flow Report on monthly basis, which will synthesize all the used and unused WM.

b. Completion of the Wastes Manifest

The WM is formed by 4 (four) sheets, filled out by the Generator and completed, successively, by the Transporter and the Receptor.

The Receptor receives the cargo, keeps a sheet of the WM for himself and delivers the last to the Generator, closing the cycle of responsibilities. IPAAM will define which sheet is to remain with each of those agents.

The WM comprehends 4 (four) sections, and in the last one it informs on the Receptor: name of the company, address, municipality, telephone number and the number of the license (OL) supplied by IPAAM; it is completed with the name of the person responsible for the reception of the waste and his position; the last field presents the date of the reception, signature and stamp of the person in charge, setting his responsibility for the waste flow.

6.5 Guidelines for Administration to Improve Waste Management

6.5.1 Requirements for Management of Waste Dischargers

a. Application and Management of Industrial Waste Inventory (WI)

SUFRAMA/IPAAM will instruct waste dischargers (i.e. factories) to fill out the WI_DB registration forms. These are being entered into a database, but SUFRAMA will be responsible to manage these in the future.

The system is now in its trial period, but there are many items that will need to be improved before it is used officially. It is not possible for SUFRAMA to make the improvements on its own, and will require IPAAM and waste dischargers (factories) to cooperate and provide information.

The system is an effective measure to establish an appropriate industrial waste management system in PIM, so it is essential for SUFRAMA to assist all of the factories which constitute PIM so they are able to submit the waste inventory. The new IWM group of SUFRAMA section will be responsible for carrying out a number of important activities such as the effective application and management of waste inventories, and serving as the point of contact to work with IPAAM and factories.

b. Application and Management of Industrial Waste Manifest System (WMS)

To establish appropriate industrial waste management, it is necessary to introduce a waste manifest system (WMS). There is currently a WMS in Amazonas State, however, even with the examples provided by advanced states such as Rio de Janeiro, it will not be easy to improve this system into a practical, usable system.

It is necessary to review the current WMS in Amazonas State and identify any points that will need to be improved. An effective measure to do so will be inviting technicians from Rio de Janeiro State and so forth.

IPAAM should promptly establish an industrial waste manifest system suitable to Amazonas State so it will be possible to conduct IWM accordingly.

c. Requirements to Create the IWM Flow

One measure to industrial waste management is creating a waste flow. The waste management (treatment/disposal) flow needs to be made based on accurate information concerning both on-site and off-site waste. IPAAM/SUFRAMA will develop a waste inventory database to improve waste management for waste dischargers (factories) as well as a waste service company database to improve waste management among WSCs. Consequently, if these databases are properly managed and operated, it will be possible to use that information to create an industrial waste flow. The following figure shows an example waste flow which will be able to be made by the WI_DB if every required data are properly input.

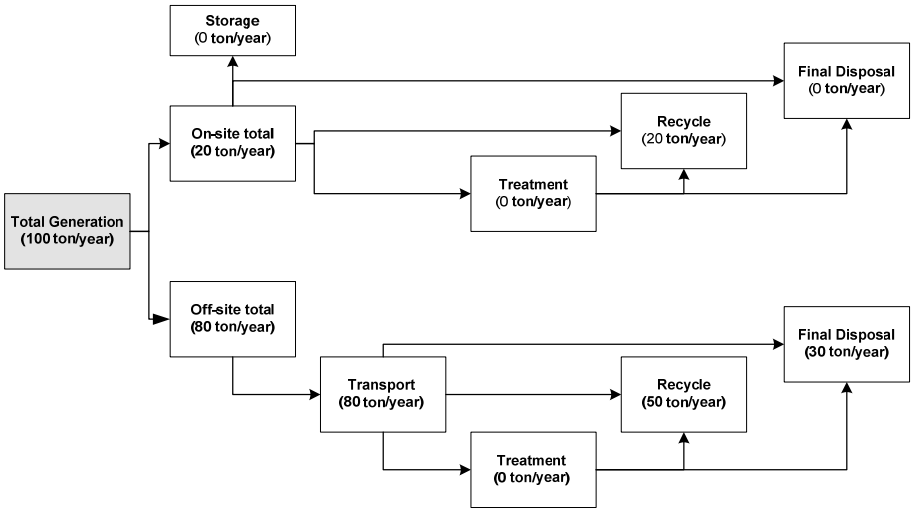


Figure 6-8: Waste flow using database

6.5.2 Requirements for WSC Management

a. Application and Management of the WSC Registry and Management System

WSCs will have to cease their activities if they do not register with this system. Consequently, this system will considerably ease IPAAM's duty to manage these companies if the data in the registry system is diligently updated. By putting this system on-line and making it possible to update the information once a year so that WSCs can be meticulously managed, it will be possible to implement appropriate industrial waste management in that administrative area.

Using this system in cases of improper disposal, such as illegal dumping, will make it possible to find the offending company.

b. Application and Management of Industrial Waste Manifest System (WMS)

The role of WSCs is critical in the manifest system. If dischargers of waste (factories) are not able to reliably entrust the treatment and disposal of their waste, it is not possible to construct

a proper system for industrial waste management. IPAAM sits at the heart of this system in their role to offer guidance to waste dischargers (factories) and WSCs to properly use the waste manifest system.

c. Requirements to Create Industrial Waste Treatment and Disposal Flow

Once it is possible for waste dischargers (factories) to select the appropriate company for collection and transportation, intermediate treatment, reuse/recycling, or final disposal using the WSC database, it will be possible to realize proper off-site management of industrial waste.

Having the information on WSCs available is extremely valuable to waste dischargers (factories) when making the waste inventory. If they do not have information regarding the off-site management of waste, it is not possible to create the on-site and off-site waste flow. In other words, this makes it possible for factories to clarify how their waste is being treated, recycled or disposed of by the WSC.

6.5.3 Good Example of Off-site IWM

a. Good Example of IW Administration in Japan: Waste Service Company Rating System and Environmental Fund in Iwate Prefecture

a.1 Introduction

Industrial waste administration in Japan is legally entrusted to prefectural and dedicated (large population) city governments by the central government according to a nationwide essentially uniform standard so that some regions are engaging in effort to promote appropriate industrial waste administration.

a.2 Background

Iwate Prefecture is located in Japan's northeast, with an area of approximately 15 thousand square kilometers and a population of around 1.4 million.

It is a picturesque prefecture largely dominated by primary industries such as agriculture, but in recent years had been wrestling to get to the bottom of a large-scale illegal dumping case near the border with Aomori Prefecture to the north, to prosecute those responsible and return conditions to normal. The industrial waste was brought from the Tokyo metropolitan area and dumped illegally, but service contractors in Iwate accepted the waste, making this a major case that required a great deal of time and resources to resolve.

a.3 System Summary

As detailed below, a company rating system and an environmental fund system were established based on Iwate Prefecture's "Ordinances for a Recycling-based Society".

a.3.1. Rating System

The prefecture announced a system to approve waste disposal contractors (and rate them) according to a prescribed and fixed standard. Waste Service Companies (WSCs) that are approved (and rated) can expect more social trust, and generators of waste have meaningful information to select preferred WSCs. Those companies are rated into one of 3 levels that is valid for 2 years.

a.3.2. The Fund

WSCs prepare a fund to be set aside for unforeseen incidents, which would be returned if it is necessary to deal with urgent incidents. Each company contributes 1 million yen, or 500

thousand yen for members of the Iwate Prefecture Industrial Waste Consortium, which operates the fund. Thanks to this fund, WSCs are able to appeal to waste generators with more reliable disposal qualification.

a.3.3. Public Announcement

The ratings and fund contributors are publicly announced on a website and in local newspapers.

Number of Companies (F.Y. 2008)

Rated WSCs: 54

Fund Contributors: 81

a.4 Results

Waste generators are able to select preferred WSCs, fostering preferred operators and eliminating malicious ones.

WSCs raise their awareness through participating in the system and improve self management and regulation.

a.5 Application to Improve Industrial Waste Management in Manaus

Fostering healthy WSCs is a key issue and lies at the heart of this study. Introduction of this system would further clarify and foster preferred operators, and the introduction of an environmental fund will enable reliable and assured service to waste generators

b. Sao Jose Dos Campos Landfill of Sao Paulo State

b.1 Outline of the Landfill

The Sao Jose Dos Campos Landfill is the first HW landfill in Brazil, established in 1985. It is also the first landfill in Brazil to have received ISO 14000. Now its area has been expanded up to 756,000 m^2. The HW landfill has been developed step-by-step and its operation area is limited. Each landfill is 120m (Length) x 30m (Width) x 8m (Height) with a roof. Each site must receive an operation license.

Current HW Landfill

New HW Landfill under Construction

b.2 Good Example

In 2007, Sao Jose Dos Campos City refused to accept hazardous wastes as well as non-hazardous industrial wastes. The factories requested that non-hazardous industrial waste

be accepted at a private hazardous waste landfill, Sao Jose Dos Campos Landfill. Then, from 2007, the HW landfill began operations to dispose the Class II-A waste (Non-HW) of factories. Accordingly, the municipal regulation has provided a new business opportunity for the private entity, and has contributed to the city to avoid mixed disposal of low-risk municipal waste with non-hazardous industrial waste that was at high risk of being mixed with hazardous waste.

Current Non-HIW Landfill

Previous Non-HIW Landfill

7. Recommendations

7 Recommendations

The purpose of the Master Plan (M/P) formulated in this study is to "establish an appropriate industrial waste management system" for the target study area in 5 years, in the year 2015. This is a highly ambitious timeframe to achieve this plan, and thus a number of difficult issues will need to be solved in order to implement it. The JICA Study Team offers the following recommendations concerning how related organizations should approach solving those issues.

7.1.1 Use of Waste Inventory

a. Effectiveness in using the Waste Inventory

Through the proper completion of the waste inventory (WI), and aggregation, analysis and management of the data, CONAMA Resolution 313 aims to effectuate the following outcomes in relation to related stakeholders.

Generators (Factories):

Factories are able to grasp actual on-site management conditions of all waste generated from factory activities and to bring to light any issues concerning the management system. In addition, this also allows factories to grasp the management conditions of off-site waste disposal and prevent the occurrence of any improper treatment or disposal.

WI Management (IPAAM):

By aggregating and analyzing the data contained in the waste inventories submitted by factories, it is possible to understand the current conditions surrounding industrial waste management in PIM and Amazonas State, as well as any issues that may exist. This makes it possible to formulate an appropriate improvement plan to resolve those issues.

Supervisor of the Industrial Pole of Manaus / Industrial Districts (SUFRAMA):

Once the management conditions of industrial waste generated in the Industrial Pole of Manaus (PIM) and the Industrial Districts are understood, this will fulfil one of the conditions required by the Amazonas State Public Ministry in order for the Industrial Districts (DIs) to acquire environmental licensing. Also, by clarifying the management conditions of industrial waste, it is possible to offer the information required by investors planning to enter PIM.

b. Aim of the Waste Inventory Database (WI_DB) System

The proper completion and use of waste inventories will bring about the above outcomes. However, at present, almost none of the above outcomes have been realized. The reason for this, as judged by the Study Team, is that concerned stakeholders do not have a strict understanding of the intent of CONAMA Resolution 313. Therefore, the WI_DB system was developed in the Study in order to resolve the issues concerning waste inventory, as outlined below:

- By standardizing the measurement units used in the WI, generators are able to easily process the report content as data, converting as much as possible into code and avoiding any discrepancies due to differences in measurement units.
- By making it as easy as possible to compile the information sought by CONAMA Resolution 313, it will eliminate differences in reporting methods and content.

- If generators correctly enter the data according to the WI_DB system user's guide, it will be possible for each factory to depict the on-site and off-site disposal of its waste. In other words, the proper completion of the WI will contribute to some extent in factories establishing a waste management system.
- Furthermore, this will allow those managing WI (i.e. IPAAM) to easily aggregate and analyze the waste inventories submitted by each factory.

c. Roles of IPAAM and SUFRAMA for the Effective Use of the WI_DB System

IPAAM has the legal right to instruct generators (factories) on the submission of the waste inventory (WI), and the legal obligation to aggregate, analyze and report the submitted WI to the federal government (IBAMA). Therefore, SUFRAMA has neither the right nor the obligation to engage on behalf of the government in dealing with WI. Nevertheless, it is recommended that IPAAM and SUFRAMA take the following measures given that IPAAM does not currently have sufficient capacity to instruct or manage WI, and since SUFRAMA has voluntarily attempted to aggregate and analyze the WI that have been submitted thus far. In addition, the results from aggregating and analyzing the WI serve as important information to be used to manage PIM/DI and acquire its environmental license.

1. Until IPAAM is competent to carry out instruction and management of the WI, it will enter into an agreement with SUFRAMA in which IPAAM will entrust part of their right and obligation concerning the WI as follows. SUFRAMA will diligently carry out the work entrusted to them by IPAAM.
   - Factories (generators), which are responsible for completing the WI, will be instructed on how to accurately prepare the data and report the results according to WI_DB system user's guide.
   - Responding to factories that have questions regarding preparation of the WI with the necessary correspondence and instruction.
   - Distribute the file for the WI_DB system according to factory requests.
   - Aggregate and analyze the aggregated information on the WI submitted by factories.
   - Analyze any issues concerning the current WI_DB system and user's guide revealed through the process of aggregating and analyzing the WI submitted by factories, and make the necessary improvements.
2. IPAAM will cooperate with SUFRAMA using the improved WI_DB system and user's guide to instruct and assist all PIM factories to submit their waste inventories.
3. In addition, IPAAM and SUFRAMA will work together to analyze the aggregated WI, and then IPAAM will prepare the report to submit to IBAMA.

d. Disseminating the WI_DB System to other States and Industrial Parks

As shown in the following image, the WI_DB system developed in the study will clarify the waste management conditions at each factory (see a.1, below). This is made possible if each factory correctly fills out files on the system (if the factories complete the waste inventory). Then, based on what is known about these conditions, it is possible for each factory to formulate a management plan for industrial waste (see b.1).

Next, the factories will use the system files to prepare their WI, and if the individual results are compiled for the industrial park, it is possible to know the waste management conditions

for it (see a.2). Then, based on what is known about the waste management conditions of the industrial park, it is possible to each industrial park to formulate their own industrial waste management plan (see b.2).

If the same is done in each State, it is even possible to clarify the waste management conditions for the country (see a.3, a.4), and formulate an industrial waste management plan (see b.3, b.4).

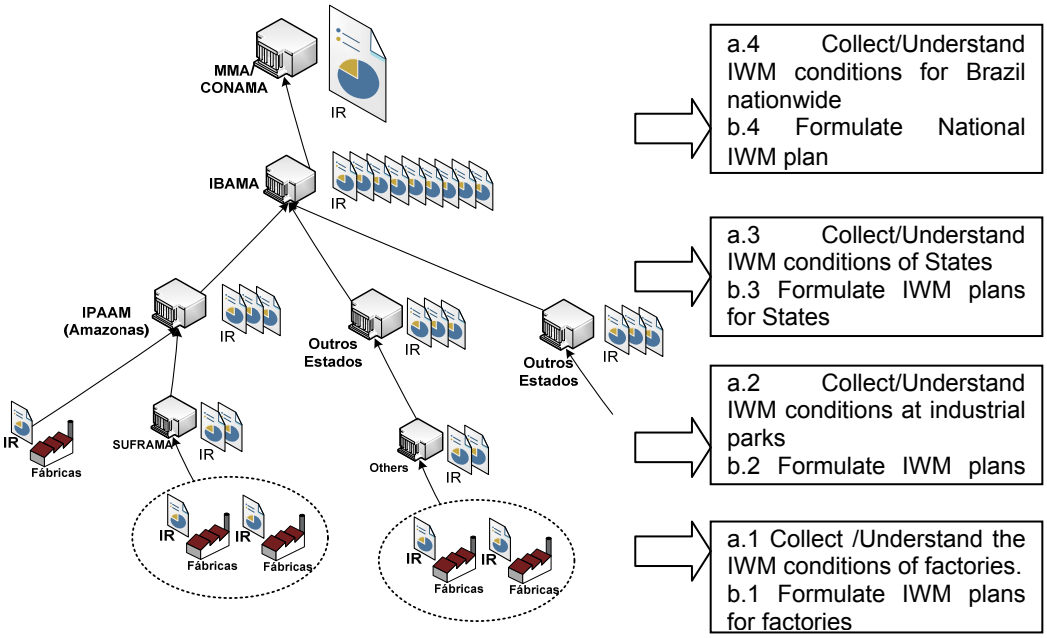


Figure 7-1: Using the WI_DB system and its relationship to understanding waste management at the factory, industrial park, state and national levels

As shown above, the Study Team considers the WI_DB system developed in this study as a highly effective tool to establish waste management systems in other States and industrial parks in Brazil, as intended by CONAMA Resolution 313. Consequently, the concerned organizations are recommended to promote dissemination of the WI_DB system and promulgate the intent of CONAMA Resolution 313 nationwide, contributing to conditions where industrial waste management systems can be established in each State.

1. First, Amazonas State will demonstrate that, using the developed WI_DB system as intended by the study team, it is possible to know the waste management conditions of each factory, related groups of factories and the State. In particular, this will confirm whether or not the waste stream can be drawn up. If so, the system will be spread to other States as follows.
2. The Ministry of Environment (MMA) collaborates with the Ministry of Development, Industry and Foreign Trade (MDIC) and the Brazilian Cooperation Agency (ABC) to hold a seminar for stakeholders in each State to disseminate the WI_DB system.
3. When holding the seminars, seek cooperation with SUFRAMA and IPAAM which are experienced in using the WI_DB system.
4. SUFRAMA and IPAAM, in response to a request by the Ministry of Environment (MMA) will actively dispatch technicians with experience in using the WI_DB system.

7.1.2 Construct a System to Manage the Licenses of Waste Service Companies

a. Aim of Waste Service Company License Management System

The background and aim of the waste service company license management system recommended in the Study are given below:

1. Currently, operation licenses for waste service companies (WSCs) are registered under various licensing codes. Because of that, it is not easy for IPAAM, which manages the licenses, or for generators (factories), which entrust the treatment and disposal of their wastes to waste service companies, to know the exact number of entities with licenses or what activities licensed entities are permitted to undertake.
2. The recommended system to manage the licenses of waste service companies would use a new environmental license code specifically for WSCs (four-digit codes starting with 33**, for municipal waste, and 34**, for industrial waste), integrating WSCs with two environmental license codes.
3. Also, the content of the license are divided into 4 major categories: 1) collection and transportation, 2) intermediate treatment, 3) recycling, and 4) final disposal. The content of each of these activities are further specified and managed in the waste service company database (WSC_DB).
4. On that basis, the information generators (factories) need to select the companies to which they will entrust disposal of their waste will be available on the IPAAM website.
5. Once the above is established, generators will be able to entrust the disposal of their wastes to trusted companies, and IPAAM will be able to eliminate companies without licenses and monitor that those which do have licenses are conducting appropriate activities.

b. Issues for the Use of a Waste Service Company License Management System and Strategy for Resolutions

As mentioned above, the waste service company license management system recommended in the Study is of great importance to "establish an appropriate industrial waste management system" in the target study area. However, it is not possible for the system to function unless waste service companies are required to obtain an operation license according to the proposed system. Therefore, it is suggested that the concerned organizations observe the following:

1. IPAAM will quickly revise its current licensing system and undertake measures so that the recommended license management system is part of the legal system. This means that it is necessary to carry out the required steps to deliberate the recommended license management system in the State Legislature (such as formulating a proposed revision of the law).
2. IPAAM will cooperate with SUFRAMA to move ahead with activities to promote the necessity of the recommended license management system to stakeholders.
3. Once the recommended license management system has become integrated into the system, IPAAM will immediately proceed with registration, and construct the WSC_DB.

4. Once the WSC_DB is constructed, IPAAM will make certain information about the newly licensed waste service companies, such as contact information and what licenses they hold, available on its website.

7.1.3 Other

a. Use of the Guidelines to Improve Industrial Waste Management

The guidelines to improve industrial waste management in PIM were produced to support the aim of the M/P to "establish an appropriate system to manage industrial waste in the Industrial Pole of Manaus." The guidelines summarize the required actions to achieve the M/P objectives upon the understanding of waste generators, waste service companies and administration. It is suggested that those three parties make effective use of the guidelines to improve industrial waste management and establish an appropriate system of industrial waste management in PIM.

b. Form a Memorandum of Understanding concerning Implementation of the Master Plan

The authority to enforce the laws necessary to implement the M/P lies primarily with IPAAM. However, the various organizations will need to cooperate in a number of ways, as outlined below, for stakeholders to comply with the law in accordance with instruction and guidance by IPAAM and fulfill their respective obligations.

- SUFRAMA will grant various investment incentives to direct PIM factories to comply with regulation. Also, for waste service companies, SUFRAMA will attract the construction and operation of appropriate treatment and disposal facilities.
- The City of Manaus will make the current landfill fee-based, and promote the construction of a new landfill that is able to obtain an environmental license.
- The Public Ministry of Amazonas State will support IPAAM to enforce laws and regulation.
- Generators and wastes service companies will comply with laws and regulation and construct the respective systems for industrial waste management.

It is recommended that IPAAM clarify the roles and responsibilities of the related organizations and form a Memorandum of Understanding between those concerned with implementing the M/P.

c. Preparing the Electronic Waste Manifest System

An electronic waste manifest system is extremely effective to trace the route of waste after it is discharged from a factory until its final destination. However, this requires not only development of the system, but also various types of expertise in how to properly operate the system. Therefore, in order to prepare such a system, it is recommended that IPAAM explore policy measures as follows.

1. Cooperate with other states that have already prepared an on-line waste manifest system, such as Rio de Janeiro State, and develop a system in Amazonas[1].

[1] Rio de Janeiro State Institute of Environment (INEA) has essentially already agreed to cooperate and dispatched an expert to present at the second workshop held on November 27, 2009.

2. In order to use the on-line waste manifest system properly once it has been developed, seek cooperation to dispatch engineers with actual operation experience.

d. Formulating an Environmental Management Plan for the Industrial Districts (DI) and Acquiring an Environmental License

At present, SUFRAMA has been advised by the Public Ministry of Amazonas State to obtain an environmental license for the Industrial Districts (DIs). In order to do so, it is necessary to formulate an environmental management plan, including the proper management of industrial wastes, for the DIs as a whole. SUFRAMA is recommended to cooperate with IPAAM to reach a policy as follows:

1. In this study, the results of a factory survey of 187 factories have been compiled into a database. That database is currently kept and managed by Modernization and Informatics General Coordination (CGMOI, under SAD) at SUFRAMA.
2. The factory survey results for 187 factories contain data on factories outside of the DI. The system engineer of CGMOI would extract only the DI survey results and compile these in order to understand the IWM conditions of the industrial districts.
3. Also in the factory survey, data was gathered not only on IWM, but also on pollution control facilities. These survey results can also be extracted and compiled only for the DI.
4. The environmental management conditions of DI will become clear through the above steps. In addition, an environmental management improvement plan for DI can be formulated by making use of the industrial waste management plan produced in this study.
5. Collaborate with IPAAM to further refine the environmental management improvement plan for DI and submit it to the Public Ministry of Amazonas State.

e. Promote Appropriate Treatment and Disposal and the 3Rs

In March 2010, the National Congress approved the Substitute of Draft Bill No. 203, National Policy on Solid Waste, which stresses appropriate treatment and disposal, and the 3Rs. Regardless of on- or off-site disposal, strengthening regulation is the most effective means to promote proper treatment and disposal, and the 3Rs.

Namely, if the administrative side (IPAAM) develops a management system and strengthens control of appropriate treatment and disposal, the off-site disposal fee will be raised. By raising the off-site disposal fee, it will not be possible for generation sources (i.e. factories) to commission 95% or more of the waste generated, as it is now. The result is that PIM factories, like those in Japan, will promote on-site 3R and reduce the amount disposed of off-site.

Also, in response to regulations and putting various environmental measures in place, disposal costs will rise even for off-site treatment and disposal. With that, waste service companies will want to reduce the disposal costs by reducing the amount of residues after treatment or by actively reusing or recycling residues. In states with more advanced destination practices, such as Rio de Janeiro, co-processing is widely used, mainly by cement factories which do not generate any waste after processing.

In order to encourage co-processing at cement factories, in addition to introducing a disposal fee, waste blending techniques that do not affect product or cement quality will need to be introduced. With that, to encourage even better treatment and disposal techniques and 3R measures, IPAAM should be encouraged to not only strengthen regulation, but to actively provide information to both waste generators and WSCs about appropriate treatment and disposal and the 3Rs, and offer training and guidance where needed. Furthermore, ideally, IPAAM would hold a training seminar for both waste generators and WSCs with the cooperation of stakeholders from states and countries with more advanced practices.

Finally, IPAAM should instruct the companies to elaborate their Wastes Management Plan, the basic instrument used to devise rational and economic handling and destination, including the procedures to minimize the wastes and costs they bear.

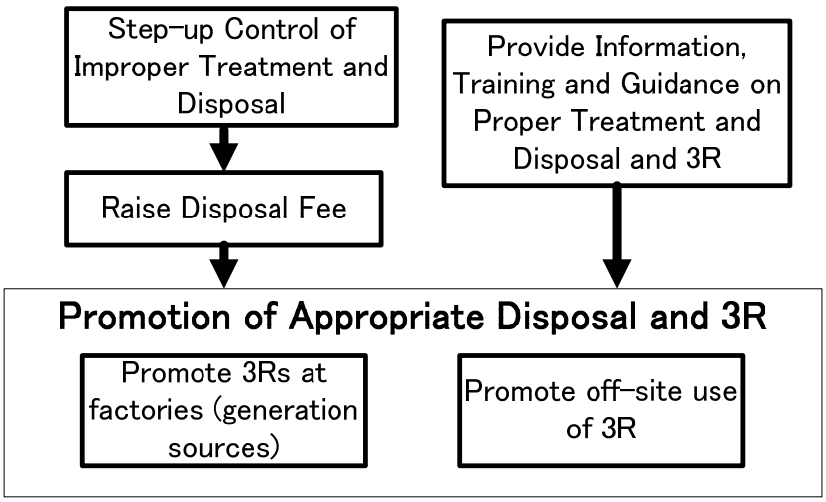


Figure 7-2: Promotion of Appropriate Disposal and 3R

f. Improve Business Environment for Waste Service Companies

The Waste Service Companies (WSC) are responsible for the proper treatment and destination of the wastes from the factories, and need to make satisfactory investments and bear the operational and maintenance costs to treat and dispose of industrial wastes entrusted to them according to proper standards. However, due to the presence in the study target area of non-licensed companies which conduct improper disposal to undercut actual costs, and the fact that the landfill accepts wastes at no charge, the conditions make it infeasible for the WSC to bear the costs brought by good practices. In order to improve the current business environment, IPAAM and SUFRAMA should cooperate and introduce the following measures to encourage WSCs to engage in proper treatment and disposal:

1. Secure demand for industrial waste services by eliminating the non-licensed companies and controlling improper treatment and disposal. For that, IPAAM and SUFRAMA should proactively publicize the information on the registration of WSCs in the database of waste services companies (WSC_DB), and inform the generators (factories) that this information is available.
2. Next, establish a sole and exclusive area at the Manaus City landfill for fee-based disposal of Class II-A/Non-hazardous/Non-inert IW, and promote separate disposal of Non-hazardous/ Non-inert IW and municipal waste in separate site.

3. Encourage the co-processing in clinker ovens as a good alternative for the destination of hazardous IW, as well as the establishment of blending plants for the wastes to be co-processed.
4. Instruct waste generators to contract WSCs registered in the WSC_DB for disposal, and provide technical information to promote on-site 3R, including training and guidance.
5. Also, hold training seminars for WSCs to instruct and guide them with information an appropriate treatment and disposal techniques.
6. Furthermore, adopt the good examples[1] from other advanced states such as Sao Paulo to improve the business environment for related industries. In Japan, many prefectures have recently introduced a "reward system for preferred waste service companies" which has been effective. In Brazil, the examples of business award and promotion are trophies and Green Stamps.

g. Cooperation between Administration, Generators and Waste Service Companies

Finally, in order to attain the "establishment of an appropriate industrial waste management system", it is essential that administration, generators and waste service companies all collaborate. In order to strengthen collaboration between these three sides, IPAAM is recommended to take the following measures.

1. Further strengthen the ties between related administrative organizations by establishing a (tentatively named) Coordination Committee for Proper Industrial Waste Management Promotion (hereafter referred to as the CCPIWMP). It is presumed that the CCPIWMP would be developed by members of the Technical Sub-Committee (TCSC) who participated in the weekly meetings during this study. The CCPGRIA will discuss the duplicated licenses, inspection, surveillance and punishment by IPAAM and SEMMA.
2. The CCPIWMP would be central to encouraging cooperation amongst and reinforcing ties between administration, waste generators, and waste service companies. To do so, the administrative side would hold a (tentatively named) Proper Industrial Waste Management Promotion Committee (hereafter simply referred to as the PIWMPC).meeting of these entities for them to come to an understanding on various issues and strengthen ties.

The administrative side would publicize, educate and train waste generators on the necessity of appropriate disposal, making them aware of their responsibilities for appropriate disposal and ensuing expenses. Then, educate and train WSCs on appropriate disposal methods, impressing upon them the necessity to implement appropriate disposal techniques.

[1] Sao Jose Dos Campos Landfill Example: In 2007, Sao Jose Dos Campos City refused to accept hazardous wastes as well as non-hazardous industrial wastes. The factories requested that non-hazardous industrial waste be accepted at a private hazardous waste landfill. Accordingly the municipal regulation has provided a new business opportunity for the private entity, and has contributed to the city to avoid mixed disposal of low-risk municipal waste with non-hazardous industrial waste that was at high risk of being mixed with hazardous waste.