

(4) ワークショップの開催(2018年5月9日)

Workshop Report on “The Availability of The
Advanced Waste Incineration Technology of Actree”

Verification Survey with the Private Sector for
Disseminating Japanese Technologies for Municipal
Solid Waste Incineration and Landfill Rehabilitation

May 2018



ACTREE Corporation

Contents

1. Purposes and procedures of technology selection	5
1.1 Purpose	5
1.2 Date and venue	5
(1) Date	5
(2) Venue	5
1.3 Program	5
2. Contents of the workshop	7
2.1 Summary of presentations	7
(1) Introduction of the incinerator and report on the experimental operation (by Mr. Atsuhiko Inami, ACTREE)	7
(2) Report on the economic analysis for operating of the incinerator (by Mr. Hideki Wada, SSDI, Chief Advisor of the Survey)	7
(3) Report on Solid waste management in Thua Thien Hue Province (by Mr. Tran Trung Khanh, Vice General Director, HEPCO)	7
2.2 Discussions	7

1. PURPOSES AND PROCEDURES OF TECHNOLOGY SELECTION

1.1 PURPOSE

The Verification Survey with the Private Sector for Disseminating Japanese Technologies for Municipal Solid Waste Incineration and Landfill Rehabilitation was initiated based on the Meeting Minutes among Japan International Cooperation Agency (JICA), Thua Thien Hue Provincial People's Committee and Actree Co., Ltd signed on December 26, 2014. As described in the Minutes, this demonstration project aims at supporting Vietnam to build a foundation to consider applying advanced incineration technologies to promote for industrial waste management in Vietnam.

Since then, the survey team has closely collaborated with Thua Thien Hue PPC as well as HEPCO – the direct counterpart to install and put into testing operation a Japanese incinerator for industrial waste in Thuy Phuong landfill. After the test run period, this incinerator has showed its effectiveness which would like to be shared to others concerning.

This workshop aims at sharing the information of this survey to other agencies in Thua Thien Hue province as well as other provinces/cities in Vietnam.

1.2 DATE AND VENUE

(1) Date

09:00 – 15:00, May 09, 2018

(2) Venue

Mondial Hotel, 17 Nguyen Hue, Hue City

1.3 PROGRAM

The program is as follows:

Time	Program	Facilitator
Morning	Seminar	
08:30 – 09:00	Registration	ACTREE
09:00 – 09:10	Opening remarks	Mr. Mizukoshi – President of Actree Co., Ltd.
09:10 – 09:20	Opening remarks from JICA representative	JICA representative

Time	Program	Facilitator
09:20 – 10:10	Introduction of the incinerator and report on the experimental operation	ACTREE
10:10 – 10:30	Tea break	Tea break
10:30 – 11:00	Report on the economic analysis	Mr.Wada – Chief Advisor
11:00 – 11:30	Solid waste management in Thua Thien Hue Province	HEPCO
11:30 – 11:40	Closing remarks	ACTREE
11:40 – 12:45	Lunch	
Afternoon	Inauguration ceremony	All participants
12:45 – 13:30	Registration and moving to Thuy Phuong	HEPCO
13:30 – 13:45	Introduction of reason and delegates	HEPCO
13:45 – 14:00	Speech by ACTREE	ACTREE's Representative
14:00 – 14:15	Speech by HEPCO	HEPCO's Representative
14:15 – 14:45	Ribbon-cutting ceremony & explanation on the incinerator by ACTREE and HEPCO	
14:45	Closing remarks	HEPCO

2. CONTENTS OF THE WORKSHOP

2.1 SUMMARY OF PRESENTATIONS

- (1) Introduction of the incinerator and report on the experimental operation (by Mr. Atsuhiko Inami, ACTREE)

Firstly, presentation gave a brief introduction on ACTREE Corporation as well as their waste incineration technologies. Then, it showed the specific information of the incinerator installed in Thuy Phuong landfill, and the result of its experimental operation.

- (2) Report on the economic analysis for operating of the incinerator (by Mr. Hideki Wada, SSDI, Chief Advisor of the Survey)

The relationships between inputs and outputs of the operation process of the incinerator were described under obtained models using the data records of the experimental operation. Based on models, the economic analysis showed that the price of hazardous waste could be different from evaluated cases. The price of 9,000 VND/kg can reach the profitable zone if just incinerating only hazardous waste; on the other hand, the price of hazardous waste has to be more than 16,000 VND/kg when the rate of non-hazardous waste is 50%.

- (3) Report on Solid waste management in Thua Thien Hue Province (by Mr. Tran Trung Khanh, Vice General Director, HEPCO)

Presentation reported the state of solid waste management in Thua Thien Hue Province, especially industrial and hazardous waste management. It also implicated the future work to put the Actree's incinerator into operation officially.

2.2 DISCUSSIONS

- Mr. Pham Tien Toan (MONRE):

Q1: What types of waste was used for test run?

A1 (by Mr. Inami): There are four types of waste were burnt, including waste oil, waste cloth contaminated oil, non-hazardous industrial waste, excavated waste from landfills

Q2: What is the profitability of the incinerator?

A2 (by Mr. Wada): The profitability of the incinerator depends on the percentage of hazardous waste incinerated. It means that incinerating as much as hazardous waste will help to improve the profitability. Mr. Wada explained this question clearly in his presentation about the profitability analysis of incinerator.

- Mr. Shu Kitamura from JICA Vietnam comments on the economic analysis report. As far as his understanding, this is the first report using the real time data recorded during the experimental operation to analyze the economic effects of a Japanese incinerator installed in Vietnam. The result of the report is one of the important parts of the project content that meet the purpose to build a foundation for considering applying advanced incineration technologies in order to promote capacity of industrial waste management in Vietnam.

Appendices

Appendix 1: Participants

No.	Name	Organization	Section/ Position
1	Mr. Pham Tien Toan	MONRE	Official, Waste Management and Environment Improvement Department (WENID), Vietnam Environment Administration (VEA), MONRE
2	Mr. Dang Anh Thu	MOC	Manager, Solid Waste Department, Technical Infrastructure Agency (ATI), MOC
3	Mr. Pham Minh Thang		President, Association of Urban Environment and Industrial Parks in Central and Central Highlands of Vietnam
4	Nguyen Quang Cuong	Thua Thien Hue Province	Vice Director, Department of Planning and Investment (DPI)
5	Phan Quoc Son		Deputy Head, Division of International Business Economics, DPI
6	Nguyen Dac Phuoc		Deputy Head, Division of Urban Development and Technical Infrastructure, DOC
7	Le Thi My Nhung		Official, Division of Urban Development and Technical Infrastructure, DOC
8	Nguyen Minh Tri		Official, Department of Foreign Affairs (DOFA)
9	Nguyen Thi Kieu Oanh		Official, Department of Foreign Affairs (DOFA)
10	Hoang Van Thu		Deputy Head, Environmental Police Division, Department of Public Security of Thua Thien Hue Province
11	Truong Van Cong		Chairman, PC's Thuy Phuong Ward, Huong Tra Town
12	Ms. Vu Thi Nhung	Environment Magazine (VEA)	Journalist
13	Mr. Đinh Quoc Huy	Vietnam Urban Environment Magazine (VUREA)	Journalist

No.	Name	Organization	Section/ Position
14	Nguyen Hoai Thuong	Thua Thien Hue Newspaper	Journalis
15	Bui Xuan Hoa	VTV8 Station	Reporter
16	Tran Cong Dien	VTV8 Station	Reporter
17	Hoang Phuong Dieu	Thua Thien Hue Radio and Television (TRT)	Reporter
18	Nguyen Van Hai	Thua Thien Hue Radio and Television (TRT)	Reporter
19	Mr. Tran Trung Khanh	HEPCO	Vice General Director
20	Mr. Le Phuoc Quang		Official, Planning Division
21	Mr. Dinh Hoang Dung		Official, Technical Division
22	Mr. Doan Anh Duc		Official, Technical Division
23	Mr. Shu Kitamura	JICA Vietnam	Senior Representative
24	Mr. Katsunori Ishikawa		Project Formulation Advisor
25	Ms. Pham Hai An		Support staff
26	Mr. Hiroharu Mizukoshi	Actree Co., Ltd	President
27	Mr. Atsushiko Inami		Director
28	Mr. Ryo Doi		Technical staff
29	Ms. Nguyen Thi Thuy An		Local staff
30	Mr. Hideki Wada	SSDi	President
31	Mr. Norihisa Hirata		Solid waste management expert
32	Ms. Le Minh Ngoc	Vietnam Waste Planning, LLC.	Solid waste management expert
33	Ms. Nguyen Thi My Quynh		Staff
34	Ms. Vu Khuyen	-	Japanese - Vietnamese Interpreter
35	Mr. Yoshihisa Tamada	Tamada Vietnam Co. Ltd	Chief Operations Officer (COO)

No.	Name	Organization	Section/ Position
36	Pham Thanh Hung	Waste Management Enterprise - Binh Duong Water And Environment Joint Stock Company (BIWASE)	Director
37	Mai Van Hoang		-
38	Le Quang Lap		-
39	Mr. Tran Thanh Ha	Viet Xanh Environmental Manufacturing – Trading – Services Company Limited (Viet Green)	General Director
40	Mr. Nguyen Huu Hai Duy		Technical Director
41	Mr. Do Nhu Nhat		Director of Branch
42	Nguyen Thanh Hong		President
43	Dang Duc Vu		General Director
44	Dang Van Tien	Da Nang Urban Environment Limited Company (URENCO Da Nang)	Vice General Director
45	Nguyen Van Chuong		Vice Director
46	Hoang Thi Ngoc		Head of Division
47	Dang Viet Hoang		Official
48	Ho Van Ha		Official
49	Mr. Huynh Minh Nhut	Ho Chi Minh City Environment Company Limited (CITENCO)	General Director
50	Mr. Nguyen Thanh Son		Vice General Director
51	Nguyen Nghia		Technical staff
52	Nguyen Huu Tien		-
53	Vo Ngoc Hung	Ha Noi Urban Environment Limited Company (URENCO Ha Noi)	-
54	Nguyen Minh Ha		-
55	Le Phuc Thai		-

No.	Name	Organization	Section/ Position
56	Mr. Bui Quang Minh	Tan Thuan Phong Co., Ltd.	-
57	Mr. Bui Duc Huy		-
58	Mr. Nguyen Van Khoat	Thang Long ENSERCO	Vice General Director
59	Mr. Nguyen Duc Thuy		-
60	Mr. Nguyen Thong Nhat	Management Board of Economic Zones in Kien Giang	Director
61	Mr. Tran Van Cuong		Manager, Division of Natural Resources and Environment
62	Mr. Nguyen Van Lap		Official
63	Nguyen Tuan Hiep	DOST	Journalist, Discovery Magazine
64	Nguyen Hanh		Official, Department of Public Security, Division of Economic Security (PA81)

Appendix 2: Presentation material

(1) Introduction of the incinerator and report on the experimental operation

ACTREE Proposal for Highly Circulated Society



2018年5月9日

〒924-0053
石川県白山市水澄町375番地
TEL +81-76-277-3380 FAX +81-76-277-3329
<http://www.actree.co.jp>

1 ACTREE CORPORATION

ACTREE Proposal for Highly Circulated Society

株式会社アクトリー前景

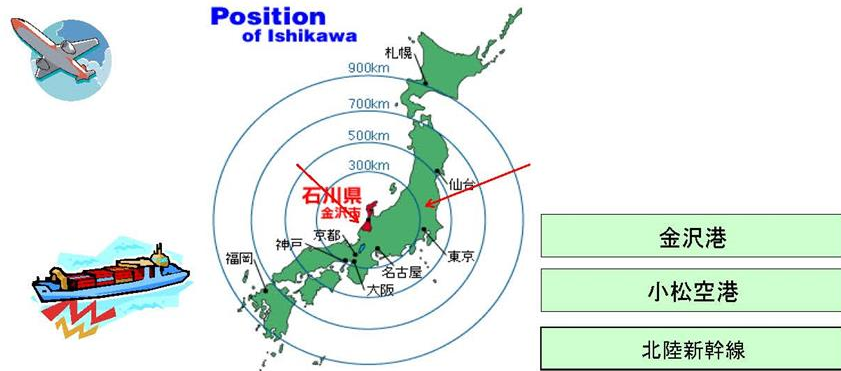
創立 1971年4月
資本金: 9,800万円



Tokyo sales office
Ginza-Maki machi Building 8-15-10, Ginza, Chuo-ku, Tokyo
(8-minute walk from JR Simbashi station)

2 ACTREE CORPORATION

当社の位置



アクトリーR&Dセンター 自社焼却プラント

ロータリーキルン (72ton/日) 発電能力770 kW/h
ストーカー (72ton/日)



栃木県 壬生町

アクトリーの製品群

- ・有害/産業廃棄物焼却炉
- ・医療/感染性廃棄物焼却炉
- ・ごみ発電
- ・汚染土壌浄化プラント
- ・焼却灰リサイクルプラント
- ・汚泥乾燥・焼却プラント



5

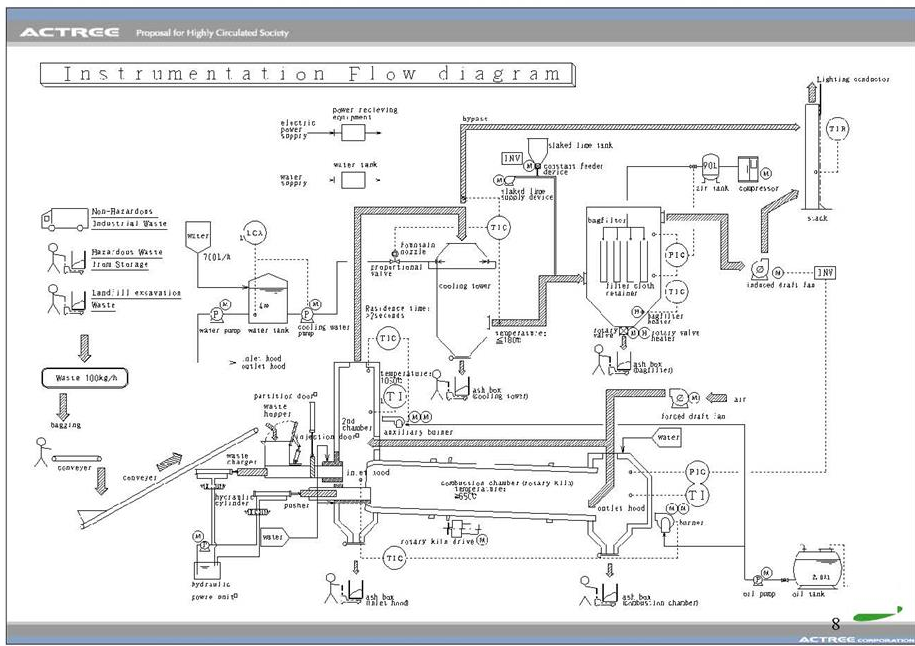
アクトリーの焼却炉紹介 不法投棄ゴミ焼却施設

ロータリーキルン(200ton/日)



本プラントは、青森県、岩手県の県境の山間部に不法投棄されたごみを処理するために建造され、不法投棄ゴミは焼却処理され自然の谷は回復された。

6



埋立地を延命、回復するための方策としての 適正な設備による焼却処理

- ・ 周辺環境の維持のため
- ・ 限られた埋立地の延命のため
- ・ 水質汚染の防止（川、農業用水、地下水）
- ・ 疫病、伝染病の防止のため



国土が狭く人口が多いベトナムは、日本と似ており、焼却処理の普及が重要だと思われる。

ただし、なんでも燃やすのではなく、ベトナムの実情に適合した関連法規制の見直しと、3Rの実践の上で、

(Reduce of waste, Reuse of waste as resource, Recycling)

適正規模の高品質の焼却炉で適正に焼却することが重要。



案件名：

ベトナム国都市ごみ焼却・埋立地再生に関する普及・実証事業

2018年5月9日

株式会社アクトリー



12



事業の背景

- 急速な経済発展により、ベトナム国内で排出される廃棄物の総量も急激に増大している。
- 各地域で収集された都市ごみは適正な中間処理を行わず埋立場に投入され、多くの地域で周辺環境の汚染と、埋立場の残余容量のひっ迫がすでに懸念されている。

13





ACTREE Proposal for Highly Circulated Society

- アクトリーとSSDI社は2015年にJICAの委託による調査でベトナム国内の既存埋立地の調査を行った。
- 19地域を調査した結果、調査した埋立場の過半数(44か所の65%)において埋立ゴミがすでに容量の95%に達していた。そこから計算される既存埋立地の残余寿命は平均3.3年と推定された。

15 ACTREE CORPORATION

実証試験焼却炉

- 実証試験用焼却炉として、様々な性状の廃棄物を焼却でき、ダイオキシン等を処理する日本で採用している方式と同様の排ガス処理装置を備えるロータリーキルン式焼却炉を選定した。
- この実証試験では焼却による廃棄物の減容と無害化をベトナムで行うための現実のコストを把握するための焼却実験とデータ取りを行った。



実証試験

- 有害廃棄物と掘り起しごみを想定しそれぞれを4種類の比率で混合し、実証試験用模擬廃棄物を作成した。
- それぞれの混合比率の廃棄物を焼却し、それぞれユーティリティーの消費量や運転コストを記録し、分析した。
- これにより、処理費を受け取れる有害廃棄物と、埋立ゴミを焼却するための最適な混合比率を推定することができる。

18



ACTREE CORPORATION



19



ACTREE CORPORATION



ACTREE Proposal for Highly Circulated Society

ベトナムと日本の規制値の違い（抜粋）

Parameters	Unit	Maximum allowance value			note
		QCVN30 2012 (Vietnam)	Air Pollution Control Act(Japan)	Air Act on Special Measures concerning Countermeasures against Dioxins	
HCl	mg/Nm ³	50	700		自治体により規制強化している
CO	mg/Nm ³	250	125		
NO, NOx	mg/Nm ³	500	335		
Hg and Mercury compounds	mg/Nm ³	0.2	0.03		
Secondary chamber combustion temperature	°C	≥1,050		≥800	不必要な高温は燃料消費と焼却炉の寿命短縮をもたらす

21 ACTREE CORPORATION

将来への展望

- 今回の実証事業にあたり、焼却に関してベトナムと日本でいくつかの規制値の違いがあることも分かった。
- 実情に即した規制の見直しや整備も必要と考える。
- ベトナムにおける、初期コスト、運転コストも考慮し、ベトナムに適合した焼却炉の設計が必要。
- 廃棄物の適切な中間処理(焼却)の必要性を人々に理解してもらうことが焼却の普及にとって重要である。



Cảm ơn bạn rất nhiều
ありがとうございました


ACTREE CORPORATION



375 Misumimachi, Hakusan City, Ishikawa-pref. 924-0053 Japan
TEL +81-76-277-3380 FAX +81-76-277-3329
<http://www.actree.co.jp>
E-MAIL main@actree.co.jp



(2) Report on the economic analysis



Economic analysis

Hideki Wada, SSDi
Chief Advisor

Our question and the study objective.

Low ← Hazardousness ⇒ High

Low ← Tipping fee ⇒ High

Low ← Income ⇒ High

Low ← Hazardousness ⇒ High

Less ← Chemical consumption ⇒ More

Low ← Cost ⇒ High

Low ← Calorie ⇒ High

High ← Fuel consumption ⇒ Low

High ← Cost ⇒ Low

How is the cost for the waste of "Hazardous but low calorie"?

How is the cost for the waste of "Non-hazardous but high calorie"?

Objective

- To incinerate hazardous waste only (100%) might be the most profitable because of high tipping fee.
- How does non-hazardous waste affect the profitability?

2

Methodology: modeling

- Supposing
 - W1: Waste oil, W2: Waste cloth, W3: Non-hazardous waste, W4: Old dumped waste
- If we get
 - Oil = $f_1(W_1, W_2, W_3, W_4)$
 - Lime = $f_2(W_1, W_2, W_3, W_4)$
 - Water = $f_3(W_1, W_2, W_3, W_4)$
 - Ash = $f_4(W_1, W_2, W_3, W_4)$
- Then
 - We can calculate the cost.

Microsoft
Word
Energy
Projects

Our model

- Available data
 - Hourly data throughout of the test run
- Function "f"
 - $f = C_0 + C_1 * W_1 + C_2 * W_2 + C_3 * W_3 + C_4 * W_4$
- Multiple linear regression
 - Determination of Cs
 - Not significant factors were omitted.

t-Values expressing the significance

SN	Utility	W1	W2	W3	W4
1	Water	0.508	0.230	0.153	0.509
2	OilTotal	-0.160	0.422	0.437	0.470
3	OilFirst	0.809	-0.285	2.15 *	-0.378
4	OilSecondary	-1.69 *	1.38 *	-2.55 *	1.50 *
5	Electricity	0.0909	1.61	2.60	0.363
6	BottomAsh	2.58 *	-2.07 *	3.47 *	-0.882
7	Lime	-0.649	1.35 *	1.48 *	0.230

Model	Waste	WasteOil	WasteCloth	WasteClothRR	NonHazardousW	DumpedWaste	Water	OilTotal	OilFirst	OilSecondary	BottomAsh	FlyAsh	Lime	Electricity
1	25	6.25	18.75	0	0	0	0.057	72	66	6	0.03	1.43	2.14	19
1	75	18.75	56.25	0	0	0	0.209	60	51	9	0.10	4.30	6.42	22
1	100	35.5	97.5	0	0	0	0.412	56	50	1	0.17	7.45	11.12	24
1	105	26.25	78.75	0	0	0	0.415	52	49	3	0.14	6.02	8.98	23
1	100	25	75	0	0	0	0.550	47	47	0	0.13	5.73	8.56	23
1	100	25	75	0	0	0	0.591	43	45	0	0.13	5.73	8.56	23
1	85	16.5	49.5	0	0	0	0.492	40	36	4	0.08	3.73	5.56	22
1	115	28.75	86.25	0	0	0	0.598	63	60	13	0.10	1.57	3.89	21
1	130	35.5	97.5	0	0	0	0.745	49	48	0	0.11	1.77	4.40	24
1	115	28.75	86.25	0	0	0	0.499	45	47	0	0.10	1.57	3.89	24
1	110	27.5	82.5	0	0	0	0.455	15	14	1	0.09	1.50	3.72	21
1	127.5	31.875	95.625	0	0	0	0.444	0	0	0	0.11	1.74	4.32	19
1	107.5	26.875	80.625	0	0	0	0.87	33	35	0	0.09	1.46	3.64	23
1	85	21.25	63.75	0	0	0	0.523	63	51	12	0.09	3.13	6.54	20
1	100	25	75	0	0	0	0.574	61	50	11	0.11	6.04	7.69	24
1	100	25	75	0	0	0	0.531	55	49	6	0.11	6.04	7.69	24
1	100	25	75	0	0	0	0.988	52	52	0	0.11	6.04	7.69	24
1	75	18.75	56.25	0	0	0	0.798	40	34	6	0.08	4.53	5.77	23
1	100	25	75	0	0	0	0.652	41	34	6	0.11	6.04	7.69	23
1	105	26.25	78.75	0	0	0	0.18	63	63	10	0.09	3.52	4.20	22
1	100	25	75	0	0	0	0.516	57	63	4	0.08	3.95	4.00	24
1	95	23.75	71.25	0	0	0	0.864	51	46	5	0.08	3.18	3.80	24
1	95	23.75	71.25	0	0	0	0.702	45	39	6	0.08	3.18	3.80	22
1	105	26.25	78.75	0	0	0	0.747	45	41	4	0.09	3.52	4.20	22
1	100	25	75	0	0	0	0.732	45	36	9	0.08	3.35	4.00	24
1	95	23.75	71.25	0	0	0	0.166	71	63	18	0.08	3.14	3.68	22
1	105	26.25	78.75	0	0	0	0.625	65	53	12	0.07	3.47	4.07	26
1	100	25	75	0	0	0	0.864	55	37	18	0.07	3.30	3.88	23
1	95	23.75	71.25	0	0	0	0.723	49	36	13	0.06	3.14	3.68	24
1	100	25	75	0	0	0	0.714	46	34	12	0.07	3.30	3.88	23
1	105	26.25	78.75	0	0	0	0.85	40	31	9	0.07	3.47	4.07	23

Microsoft
Word
Energy
Projects

Obtained model

- Water(m³/h) = 0.292 + 0.00193 * W(kg/h)
- OilTotal(liter/h) = 43.0 + 0.0837 * W(kg/h)
- OilFirst(liter/h) = 40.6 + 0.118 * W3(kg/h)
- OilSecondary(liter/h) = 10.4 - 0.740 * W1 + 0.197 * W2 - 0.173 * W3 + 0.414 * W4
- Electricity(kWh) = 18.1 + 0.0618 * W2(kg/h) + 0.0506 * W3(kg/h)
- BottomAsh(kg/h) = -0.0166 + 0.0192 * W1(kg/h) - 0.00508 * W2(kg/h) + 0.00298 * W3(kg/h)
- FlyAsh(kg/h) = 0.745 + 0.415 * Lime(kg/h)
- Lime(kg/h) = -0.837 + 0.0793 * W2(kg/h) + 0.0891 * W3(kg/h)

Evaluated cases

- Cases
 - Case 1: under the same conditions as the test run (eight-hour operation, one hour launching, one hour cooling-down)
 - Case 2: 24-hour operation
- Parameter setting
 - Parameters may have ranges due to uncertainties.
 - Some parameters were given with ranges.

Tipping fee (VND/kg)

	lowest case	Standard case	Highest case
Hazardous industrial waste	8,000	10,000	12,000
Non-hazardous industrial waste	1,600	2,000	2,400
Excavated waste from landfills	550	550	550

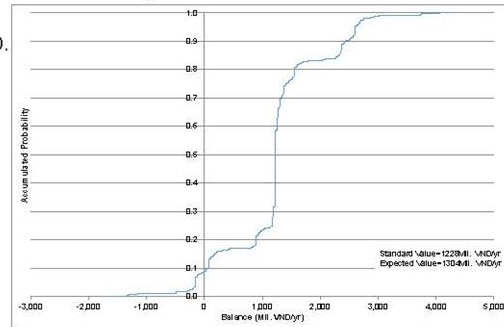
Utilities

- Worst case: obtained data
- Standard case: 75% of the obtained data
- Best case: 50% of the obtained data
- * The test run was conducted in safety sides.

- Profitability will be given probably.

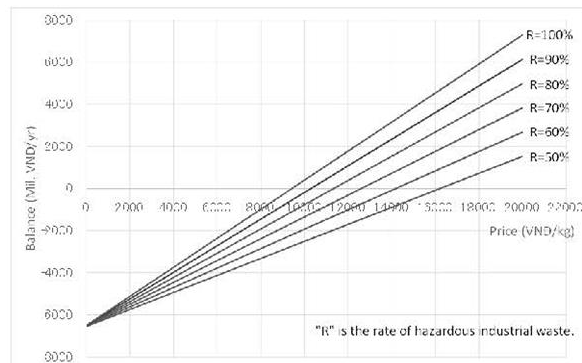
Probable profitability

- X axis: Profitability (financial balance)
- Y axis: Accumulated probability
- Explanation of the figure
 - The balance ranges between -170 and +5000 Mil. VND/year.
 - The probability going to minus is 10%.
 - The expected balance is 1304 Mil. VND.



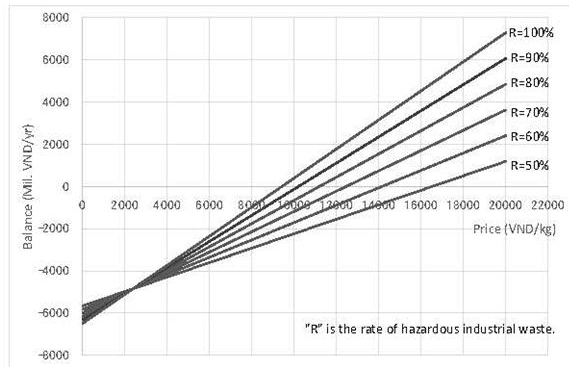
Expected probability curve under Case 2 (24 hour-operation) (1)

- Mixture of hazardous waste and non-hazardous waste
- Hazardous waste 100%⇒price 9,000 VND/kg
- Hazardous waste 50%⇒price 16,000 VND/kg (non-hazardous=3,200 VND/kg)



Expected probability curve under Case 2 (24 hour-operation) (2)

- Mixture of hazardous waste and old dumped waste
- Hazardous waste 100%⇒price 9,000 VND/kg
- Hazardous waste 50%⇒price 16,000 VND/kg (non-hazardous=3,200 VND/kg)



Conclusion

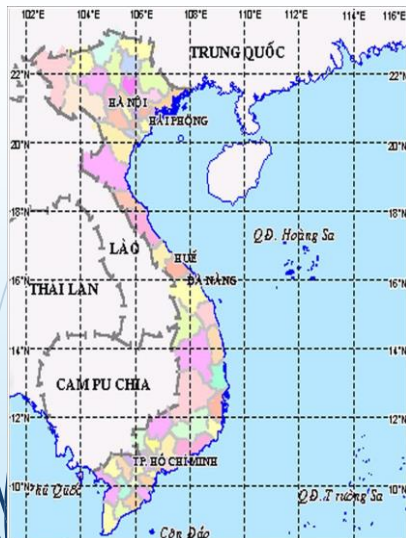
- Incinerate as much as hazardous waste because it improves the profitability. The price of 9,000 VND/kg can reach the profitable zone.
- If enough amount of hazardous waste can not be obtained, non-hazardous waste can be incinerated. However, the price of hazardous waste has to be more than 16,000 VND/kg, when the rate of non-hazardous waste is 50%.



トゥアティエンフエの ごみ処理

フエ市 2018年5月

1



・トゥアティエンフエ省はベトナムの中部沿海域の地方であり、面積：5,033.2km²、人口：約1,130,000人

・フエ市、フオントゥイ区、フオンチャー区、ナムドンとアルイと言う山の町2つ、デルタの町4つ（クアンディエン、フオンディエン、フーヴァン、フーロック）合計9の行政区域を含む

2



生活ごみ

- ・ JICAと国土省インフラ技術局のサポートを頂き、2016年6月にトゥアティエンフエ省が「2050年のビジョンをもち2030年までのごみ処理計画」を発行した。本計画を公表して実施を進んでいる。
- ・ 現在省内の発生する生活ごみ：570トン／日
- ・ 収集量：495トン／日
- ・ 処理：現在主に埋め立ての形で処理されている。衛生基準を満たす場所は2か所あり。トゥイフオン処理所で1日に200トンくらいがコンポストされている。

3



産業ごみや有害ごみ

- ・ 経済団地2か所、工業団地が6か所あり。その団地に活躍している企業はみんなごみ収集・処理に関して契約を締結している。
- ・ 有害ごみ：「2020年までトゥアティエンフエ省の有害ごみ収集・搬送・処理の提案」が承認された。有害ごみ発生所のリストアップを実施した。結果として、有害ごみ105種類あり、有害ごみ発生所として登録したのは196企業であった。
- ・ 省内発生している有害ごみは1日に900キロくらい、毎日収集・処理され、徹底的に管理されている。

4



HEPCOの有害ごみ収集・処理

有害ごみの管理する許可を頂いた省内唯一の企業であるHEPCOには、処理できる有害ごみの種類がまだ少ない状態である。今後Actree社やその他の焼却炉、ごみ処理設備を追加して、その他すべての有害ごみを書類できるように許可が取れるように申請する。

5



ACTREE焼却炉を有効的に運用する

焼却炉の許可書の手続きを完成し、続いて焼却炉を有効的に運用できるように約束する。

- ・まず、焼却炉が使用できるように許可書を申請する
- ・顧客に情報を提供し、ごみ焼却のサービスの広告をする。
- ・経済的に焼却炉を運用する。発熱量の高いと低いごみ、有害ごみと無害ごみ、古い埋め立てのごみを含めて処理する。焼却炉を連続的に運用する。
- ・焼却炉の維持メンテナンス等に関してActree社と連絡を継続。

6



ご清聴
ありがとうございました。

7

(5) 有害廃棄物に関する潜在的顧客の検討

Report on Potential Customers for Hazardous Waste
in Thua Thien Hue Province

Verification Survey with the Private Sector for
Disseminating Japanese Technologies for Municipal
Solid Waste Incineration and Landfill Rehabilitation

June 2018



ACTREE Corporation

Contents

1. Purposes and procedures of technology selection	5
1.1 Purpose of this report	5
1.2 Analyzed data	5
1.3 Framework of the analysis	5
2. Results of the analysis	6
2.1 Features of hazardous waste in Thua Thien Hue Province	6
2.2 Specifying large-scale generators of hazardous waste	7
2.3 Analysis of hazardous waste from the top 7 (large-scale generators)	7
3. How to approach the top 7	10
3.1 Points to consider	10
3.2 Interview with the top 7	10

1. PURPOSES AND PROCEDURES OF TECHNOLOGY SELECTION

1.1 PURPOSE OF THIS REPORT

This report is developed to find potential customers that provide HEPCO with hazardous waste in order that the test plant provided by ACTREE corporation in this verification survey founded by JICA is continuously run after this survey terminates.

1.2 ANALYZED DATA

Amount of hazardous waste (as of 2016) and lists of waste generators in Thu Thien Hue province were provided by DONRE (Department of Natural Resources and Environment) of TTH province through HEPCO.

1.3 COMPONENTS OF THE ANALYSIS

- Analyzing hazardous waste in Thu Thien Hue province
- Specifying the large-scale generators of hazardous waste
- Analyzing hazardous waste of the large-scale generators
- Listing points to consider before approaching the large-scale generators
- Listing points to be clarified when approaching the large-scale generators

2. RESULTS OF THE ANALYSIS

2.1 FEATURES OF HAZARDOUS WASTE IN THUA THIEN HUE PROVINCE

- Amount of generated hazardous waste: 474,520kg/year
- Number of types of generated hazardous waste: 99 types in the Circular No. 36/2015/TT-BTNMT, 432 types of hazardous waste are listed in the list of hazardous wastes (Appendix 1 of the circular).
- Number of generators of hazardous waste: 161 entities
- Number of sources to discard hazardous waste: 339 sources
Note: The number of generators and the number of sources are different because some companies have their branches.
- Amount of hazardous waste from only the top 8 types of hazardous waste counts for 87% of total hazardous waste in Thua Thien Hue province; The 8 types of waste are infectious waste (130101), waste sludge containing hazardous substances from process of biological treatment of industrial wastewater (120605), Waste detergent solution and other organic solvent (030603), cloth contaminated by diesel oil (180201), cytotoxic pharmaceutical products (130103), fixed solutions (190104), transmission oil (170304) and unknown type of waste. *The numbers in brackets show hazardous waste code stipulated by the Circular No. 36/2015/TT-BTNMT.

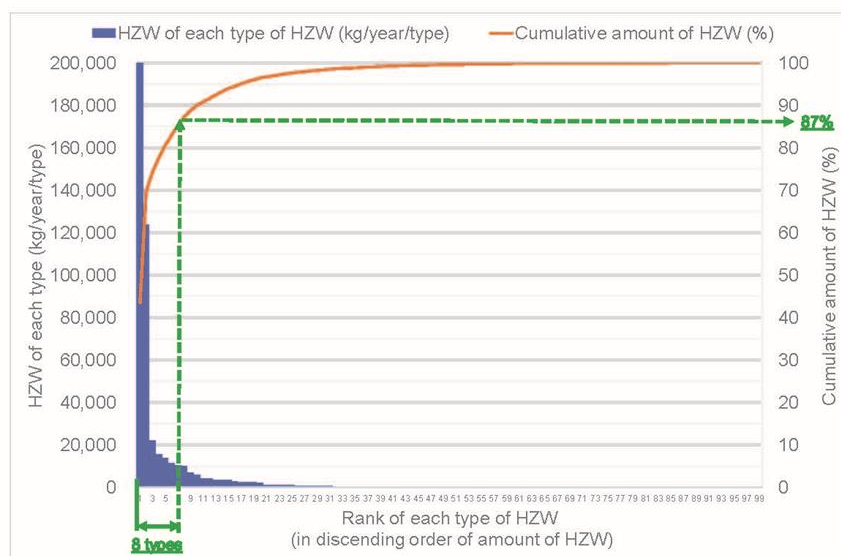


Figure 2-1 Amount of hazardous waste by each type and cumulative amount of hazardous waste

2.2 SPECIFYING LARGE-SCALE GENERATORS OF HAZARDOUS WASTE

- The following figure shows amount of hazardous waste of each entity arranged in descending order and cumulative amount of hazardous waste from the top in terms of waste amount.
- According to the figure, amount of hazardous waste from only the top 7 counts for 87% of total hazardous waste in Thua Thien Hue province.
- Accordingly, it is necessary to approach the large-scale generators, top 7 to secure enough amount for the incinerator.

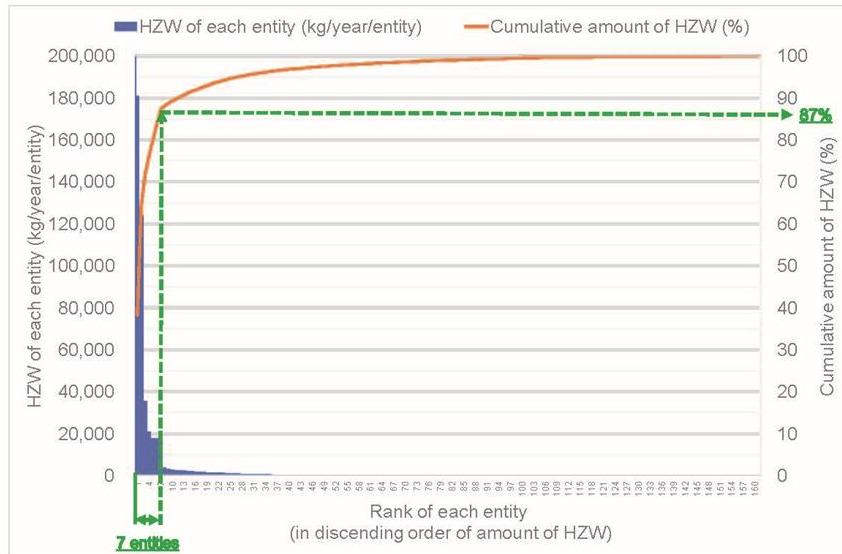


Figure 2-2 Hazardous waste of each entity and cumulative amount of hazardous waste

2.3 ANALYSIS OF HAZARDOUS WASTE FROM THE TOP 7 (LARGE-SCALE GENERATORS)

- The following table shows types and amount of hazardous waste from the top 7, and the following figure shows ratio of amount of three types of hazardous waste generated in large amount to the total amount of hazardous waste from the top 7.
- Amount of hazardous waste from the top 7 is 414,114kg/year (approximately 414 ton/year). This amount of hazardous waste is 1.5ton/operation-day if the number operation days per year of the incinerator is 280 days/year.
- There are some hazardous wastes inappropriate for incineration but they count for only 1.2% of the total amount. The hazardous wastes inappropriate for incineration include bottom ash and slug from a hospital.

- Infectious waste from hospitals is approximately 47% of the total hazardous waste from the top 7.
- Amount of waste sludge from only a company is larger following the infectious waste, which counts for approximately 30%.

Table 2-1 Types and amount of hazardous waste from the top 7

Name of HZW	HZW code	1	2	3	4	5	6	7	Total			
		Hue Central hospital kg/year	JZ Infrastructure Investment and Development One-member Limited company kg/year	Provincial general hospital kg/year	Thua Thien Hue electric company kg/year	Luks Cement Co., Ltd kg/year	HanesBrand Limited company - Hue branch kg/year	Healthcare center in Huong Thuy town kg/year	kg/year	%	%	
Total		178,854	124,190	33,400	21,116	17,520	17,554	16,638	414,114	100.0	100.0	
Acceptable HZW for incineration	1	Infectious waste	130101	146,000	0	30,000	0	0	12	16,638	414,114	100.0
	2	Waste sludge containing hazardous substances from process of biological treatment of industrial wastewater	120605	0	123,900	0	0	0	0	0	123,900	29.9
	3	Waste detergent solution and other organic solvent	030603	21,900	0	0	0	0	0	0	21,900	5.3
	4	Cytotoxic pharmaceutical products	130103	10,950	0	2,950	0	0	0	0	13,900	3.4
	5	Fixed solutions	190104	0	0	450	10,559	0	0	120	11,129	2.7
	6	Transmission oil	170304	0	0	0	10,352	0	0	0	10,352	2.5
	7	(Unknown)	060203	0	0	0	0	9,980	0	0	9,980	2.4
	8	Cloth contaminated by diesel oil	180201	0	1	0	5	150	9,480	0	9,636	2.3
	9	Waste engine oil	170204	0	279	0	0	3,840	0	0	4,119	1.0
	10	Printing ink which contain hazardous substance	090201	0	0	0	0	0	3,600	0	3,600	0.9
	11	Sludges containing dangerous substances from other treatment of industrial waste water	120606	0	0	0	0	3,500	0	0	3,500	0.8
	12	Waste engine oil, gearbox oil and lubricating oil	170203	0	0	0	200	0	2,112	0	2,312	0.6
	13	Waste ink containers	080204	0	0	0	0	0	2,244	2	2,246	0.5
	14	Waste chemicals containing hazardous substances	130102	4	0	0	0	0	0	120	124	0.0
	15	Capacitor	190201	0	0	0	0	50	0	0	50	0.0
	16	Ink	160109	0	0	0	0	0	36	0	36	0.0
	17	Used oil filter	150102	0	0	0	0	0	36	0	36	0.0
	18	Used activated carbon	021102	0	0	0	0	0	24	0	24	0.0
	19	Waste hydraulic oil	170107	0	10	0	0	0	0	0	10	0.0
Inappropriate HZW for incineration	20	Inorganic plant protection products, wood-preserving agents and other biocides	021101	0	0	0	0	0	10	0	10	0.0
	21	Package and container for chemicals	180101	0	0	0	0	0	0	0	0	0.0
	22	Hard packages (not containing halogenated chemical)	140106	0	0	0	0	0	0	0	0	0.0
	23	Photo developer solution (waste)	190101	2,035	0	450	0	0	0	120	2,605	0.6
	24	Bottom ash and slag containing dangerous substances	120105	0	0	1,500	0	0	0	0	1,500	0.4
	25	Flourescent tube	160106	240	1	40	2	120	18	21	441	0.1
	26	Mobile battery	160112	0	0	0	0	150	120	0	270	0.1
	27	Broken electrical parts and electrical equipment	160113	0	0	0	0	0	24	0	24	0.0
	28	Used broken equipments containing mercury and other heavy metals	130302	0	0	1	0	0	0	1	2	0.0

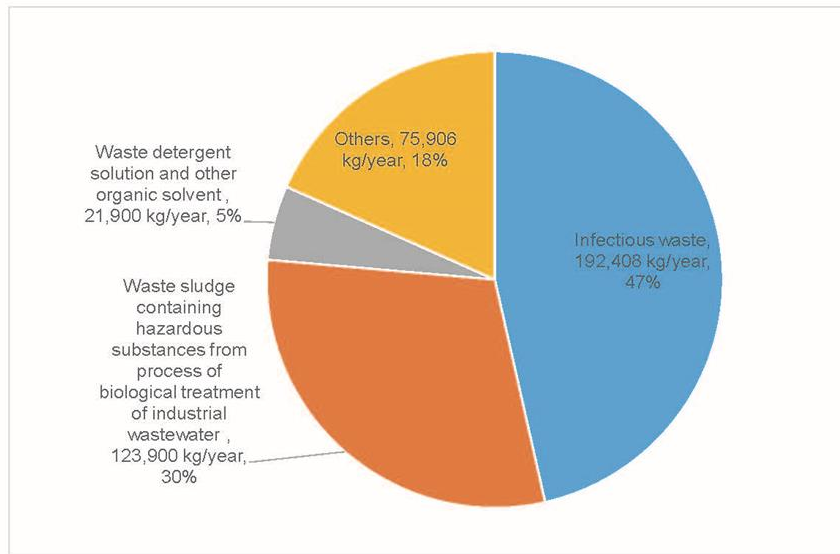


Figure 2-3 Composition of hazardous waste from the top 7

3. HOW TO APPROACH THE TOP 7

3.1 POINTS TO CONSIDER

The following points should be considered for approaching the top 7, large-scale generators of hazardous waste.

- Amount of infectious waste is the largest amount (47%). It contains PVC (polyvinyl chloride), which causes corrosion effect for parts of incinerators. It is necessary to incinerate this type of waste with mixing other types of wastes that contain no or less PVC.
- Amount of waste sludge is larger (30%) following the infectious waste. In general, these kinds of waste contain plenty of water and it may be then difficult to feed them into process of the incinerator. It is necessary to make sure the sludge property and confirm or find a way to feed the sludge into process of the incinerator.
- The hazardous wastes inappropriate for incineration include bottom ash and slug because a hospital burns hospital wastes. It is a considerable point if HEPCO receives waste before burning waste in consideration of the future possibility that it is difficult for them to keep appropriate treatment of hazardous waste. Estimated amount of waste before burning is 15,000kg/year (54kg/operation-day), assuming that ash rate is 10%.
- The amount of hazardous waste is 1.5ton/operation-day from the top 7. This amount counts for around 60% of capacity of the incinerator, 2.4 ton/day (100kg/hour) but it does not meet all the capacity. In order to meet the capacity, there are three options:
 - (1) to secure hazardous waste from small-scale generators in Thua Thien Hue province,
 - (2) to secure hazardous waste from generators in other province and
 - (3) to incinerate hazardous waste dug away from the hazardous waste landfill in Thua Thien Hue province.The third option would contribute to prolong lifetime of the landfill.

3.2 INTERVIEW WITH THE TOP 7

Interviews with the top 7 should be conducted in consideration of the above points. In the interview, the following points should be clarified.

- Current way to treat hazardous waste (where to treat, how much to pay for the treatment)
 - Current issues of the treatment of hazardous waste
 - Possibility to contract with HEPCO
- Conditions to contract with HEPCO

People's Committee
Thua Thien Hue Province
Socialist Republic of Vietnam

Socialist Republic of Vietnam

Verification Survey with the Private Sector for
Disseminating Japanese Technologies for
Municipal Solid Waste Incineration and
Landfill Rehabilitation

Summary Report

Sep 2018

Actree Corporation

Project Structure

Vietnam

Environment/
Energy/
Solid Waste
Management

Verification Survey with the Private Sector for Disseminating Japanese Technologies for Municipal Solid Waste Incineration and Landfill Rehabilitation Actree Corporation (Ishikawa Prefecture)

2013
Verification
Survey

Development needs of Vietnam

- Existence of unsanitary management for increasing waste
- Difficulty to construct new landfills
- Expectation to future availabilities of incineration technologies

Contents of the Verification Survey

- Incineration project consistent to the policy of the ISWM
- Proposal of an incineration project considering the current situations and difficulties in the target city of Thua Thien Hue Province
- Verification of an incineration project through a pilot project using a multi-purpose incinerator in the target city
- Dissemination of the outcome from the pilot project

Technology/Product of the company



Rotary kiln type incinerator

- Applicable to various types of waste
- Effective gas treatment technology
- Maintenance formation supporting small size and large size incinerators

Expected outcome in Vietnam

- Development and dissemination of sanitary solid waste management using an incinerator
- Development and dissemination of an integrated solid waste management using an incinerator
- Improvement of the environment of Vietnam by the development and dissemination of an ISWM

Expected outcome of the Japanese company side

- Current situation**
- Shrinking of the domestic solid waste management market caused by business expansions of Japanese companies such as manufactures
- Future Action**
- Growth and sustainability of Actree by the overseas expansion
 - Activation of the local economy by the ripple effects to Ishikawa companies

ISWM: Integrated Solid Waste Management

1. Outline of the Project

i) Project name

- Socialist Republic of Vietnam, Verification Survey with the Private Sector for Disseminating Japanese Technologies for Municipal Solid Waste Incineration and Landfill Rehabilitation

ii) Target site

- Thua Thien Hue Province in Vietnam

iii) Vietnamese counterpart

- Thua Thien Hue People's Committee

iv) Project duration

- 30 January 2015 – 31 October 2018

v) Project purpose

- To improve unsanitary situations of final disposal sites as well as to expand the lifetimes of the landfills by waste reduction in terms of volume and weight through the development of technically and economically sustainable solid waste incineration system (multi-purpose incineration model) in Vietnam

vi) Contents of the Survey

a) Verification

- Facilities with proper a scale and technologies suitable for Vietnam will be constructed.
- Avoidance of secondary pollution for incinerating various types of waste will be considered carefully. Especially, safety will be secured when incinerating waste containing hazardous substances.
- An experimental facility will be manufactured considering local conditions and information.
- Training programs will be provided for developing human resources through technical guidance on operation and maintenance for the experimental facility.
- A solution for lifetime expansion of landfills will be proposed based on the experiment using the multi-purpose incinerator.

b) Dissemination

- A profitable model for sustainable solid waste management will be proposed.
- An integrated solid waste management system including a fee recovery system by the counterpart agency will be proposed for generating an integrated solid waste management.
- The result of the project will be shared with related agencies, aiming the nationwide dissemination of the experimental facility.
- A formation for providing waste management services will be formulated cooperating with some local partners such as HEPCO which can implement solid waste incineration including landfill rehabilitation.

2. Project implementation

(1) Verification

- An incinerator with the capacity of 1.2 tons per day (100 kg/hour) was constructed in the major landfill of Thua Thien Hue Province: Thuy Phuong Landfill. This small experimental incinerator can be used for various types of waste.
- The incinerator is equipped with an advanced gas treatment system using a bag filter.
- The process flow is shown below.

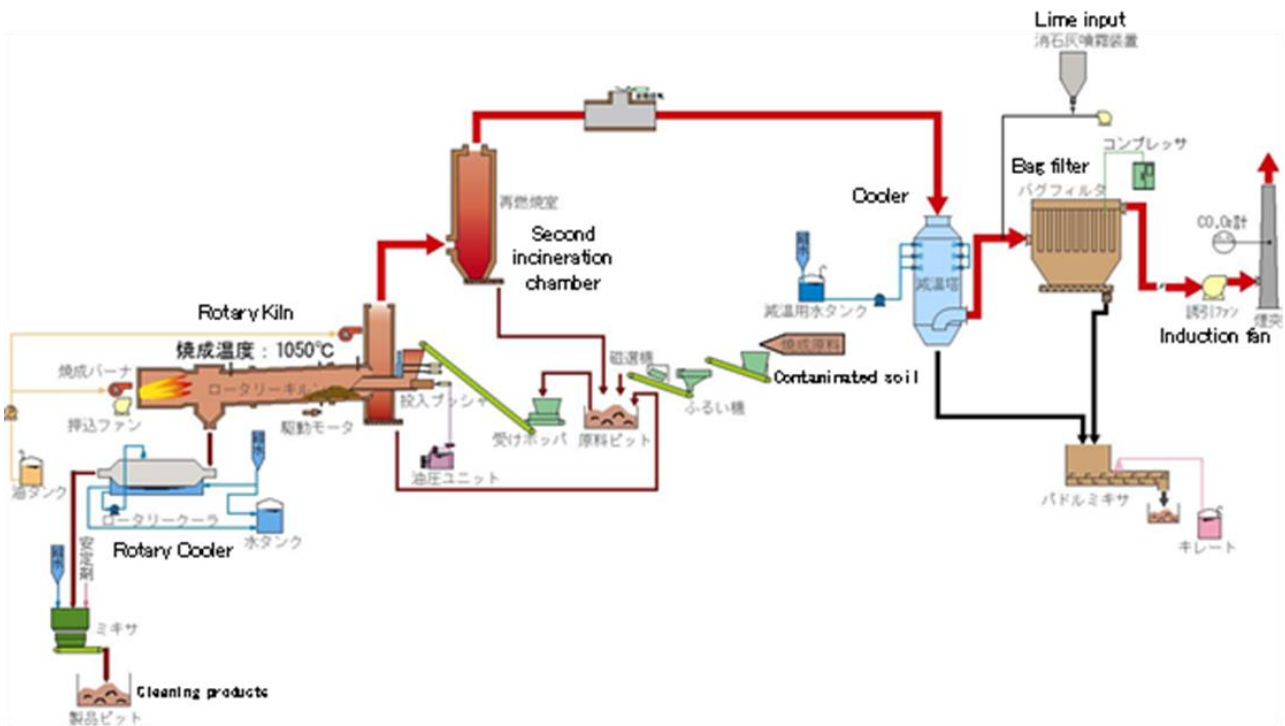


Figure Process flow of Actree's incinerator

- An experiment was planned for four types of combinations of waste composed of hazardous industrial waste (waste oil and waste cloth), non-hazardous industrial waste and excavated waste from the landfill, changing of the mixture rates

Table Experimental models by the mixtures of various types of waste

Models	Hazardous waste			Non-hazardous waste			Total
	Hazardous industrial waste		Waste oil	Waste cloth	Non-hazardous industrial waste	Waste similar to landfill excavated waste	
	Waste oil	Waste cloth					
Model 1	100.0% 100kg/h	25.0% 25.0kg/h	75.0% 75.0kg/h	0.0% 0	- -	- -	100.0% 100kg/h
Model 2	30.0% 30kg/h	7.5% 7.5kg/h	22.5% 22.5kg/h	70.0% 70kg/h	55.0% 55.0kg/h	15.0% 15.0kg/h	100.0% 100kg/h
Model 3	20.0% 20kg/h	5.0% 5.0kg/h	15.0% 15.0kg/h	80.0% 80kg/h	65.0% 65.0kg/h	15.0% 15.0kg/h	100.0% 100kg/h
Model 4	10.0% 10kg/h	2.5% 2.5kg/h	7.5% 7.5kg/h	90.0% 90kg/h	75.0% 75.0kg/h	15.0% 15.0kg/h	100.0% 100kg/h

- The experiment was conducted from 21 November 2017 to 23 December and the amounts of ash (bottom and fly ash), required water, required fuels, required lime and required electricity were recorded.

Table Result of the experiment

Date	Model	Incinerated waste kg/d	Ash		Water m3/d	Fuel		Lime kg/d	Electricity kWh
			Bottom kg/d	Fly kg/d		1 st chamber L/d	2 nd chamber L/d		
11/21	Preparation by Model 1	-	-	-	-	-	-	-	268
11/22		-	0	42	-	74	304	-	230
11/23		600	2	34.6	3.41	90	288	-	281
11/24		600	0.1	35.0	3.94	74	327	-	283
11/27	Model 1	560	0.6	33.8	3.86	50	318	43	373
11/28		600	0.5	38.1	4.32	63	327	24	371
11/29		600	0.4	19.8	4.37	104	293	23	371
11/30		600	0.2	11.0	4.14	77	325	24	356
12/1		705	0.6	9.6	3.81	37	245	24	352
12/2	Equipment adjustment	-	-	-	-	-	-	-	-
12/4	Model 2	600	0.8	7.6	3.59	56	370	25	371
12/5		600	0.6	14.2	3.33	50	353	24	365
12/6		600	1.4	22.6	3.50	55	346	24	369
12/7		-	-	-	-	-	-	-	-
12/8		600	0.8	16.8	3.36	65	334	23	371
12/9		645	0.6	21.4	3.60	41	353	24	370
12/11	Model 3	595	1.6	6.6	3.19	53	383	25	373
12/12		610	0.8	3.8	3.19	36	375	24	355
12/13		615	0.4	4.4	3.42	45	387	26	377
12/14		600	1.4	3.8	2.92	29	349	24	363
12/15		580	1.8	6.8	3.22	39	376	26	362
12/16	Equipment adjustment	-	-	-	-	-	-	-	-
12/18	Model 4	600	2.4	18.6	45.00	45	395	26	326
12/19		605	0.8	19.4	2.96	32	335	24	367
12/20		600	0.6	21.2	3.28	33	354	23	376
12/21		600	1.2	21.2	3.47	33	361	24	373
12/22		500	0.8	19.0	2.57	34	317	20	362
12/23	Equipment adjustment	-	-	-	-	-	-	-	-

- The experiment was ended after recorded good data and proved that the incinerator can properly incinerate various types of waste of Vietnam.
- By using the data obtained from the experiment, the profitability of the facility was estimated by estimating the prices of the tipping fees paid by the waste generators so as to reach the break-even points. If only hazardous waste are incinerated, the tipping fee for them 9000 VND/kg. If 50% of non-hazardous waste including landfill excavated waste, the high prices for hazardous waste of 16000 VND/kg have to cover the low prices for non-hazardous waste.

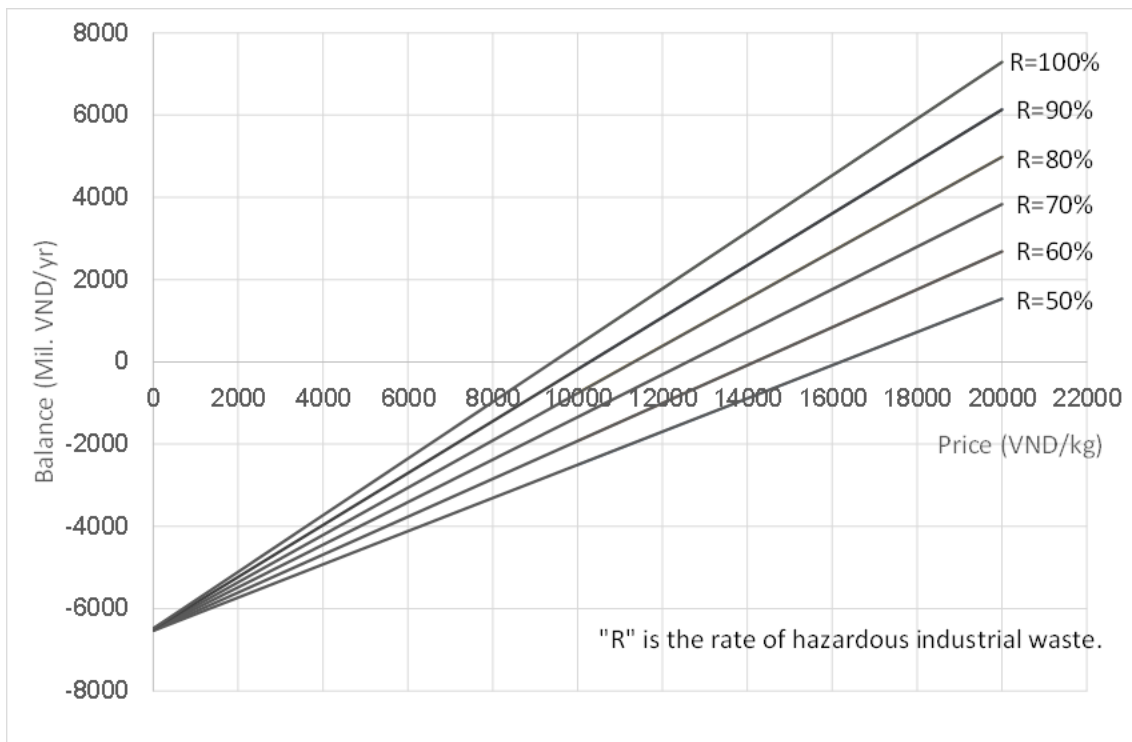


Figure the prices of the tipping fees for hazardous waste so as to reach the break-even points

- In the course of the experiment, six members of HEPCO (solid waste operator of Thua Thien Hue Province) were trained for how to operate and maintain and how to ensure safety by using the operation manual so that HEPCO can operate the incinerator by itself even after the project.
- An training tour in Japan was effectively implemented for two members of HEPCO in December 2017.

(2) Dissemination

- Based on the data analysis analyzing the data recorded in the experiment, the facility may reach the break-even point by the tipping fee of 9000 VND/kg for hazardous waste when only hazardous waste is incinerated for 24 hours continuously. In the case of mixture incineration with non-hazardous waste including excavated waste from existing landfill, the tipping fee of 16000 VND /kg for hazardous waste makes the facility profitable, when the mixture rate is 50%.
- A workshop was held on 9 May 2018 in Thua Thien Hue Province and the result of the project was shared with the participants. On the same day, the opening ceremony was also held in the facility location.
- The survey team visited the top seven factories sharing nearly 90% of generated hazardous waste in Thua Thien Hue Province in July 2018 and the availability of the incinerator was discussed so that enough amount of waste will be secured even after the project.



3. Business development

- Cooperating with some Vietnamese companies, some supervisors will be dispatched by Actree upon necessity.
- When some potential customers appear, Actree will place a business office cooperating with some Vietnamese companies.
- Actree will establish a parts supplying office in Vietnam cooperating with some Vietnamese companies.
- Marketing will be started from the some potential customers which participated in the workshop and the trade fair held by MONRE. Keeping a good relation with HEPCO, the incinerator in Thua Thien Hue Province will be utilized as a model plant.