MILCO (Pvt) Ltd.

Summary Report

Sri Lanka

Verification Survey with the Private Sector for Disseminating Japanese Technologies for Wastewater Treatment by Ozone Oxidation Method with Swirling Jet

February 2017

Japan International Cooperation Agency

Huens Co., Ltd.

Contents

1. BACKGROUND

In Sri Lanka, since the end of the civil war in 2009, the country has achieved a rapid economic growth of high annual rate (4.46% and 5.18% from 2014 to 2015) due to an influx of foreign investments and the construction of many industrial plants and factories in many places and thus causing pollution of the environment. The Sri Lankan Government has been trying to curtail the pollution of the environment, including the prevention of water pollution, in order to improve the standard of life of the people. It has made the industrial plants and factories duty-bound to appropriately process the wastewater. In the latter half of 5-year period of the Government National 10-year Development Plan (called Mahinda Chinthana for 2006 to 2016), the emphasis is on the countermeasures against environmental pollution – one of the challenges the country is now facing.

There is a concern that the MILCO Digana Factory (manufacturer of dairy products totally owned by the Ministry of Rural Economic Affairs) has caused the similar environmental and public health problems by discharging industrial wastewater into streams or underground without proper treatment. It has been learned from Huens' preliminary report that the factory was facing serious problems to meet environmental standards for discharged wastewater and Renewal of Factory's Environmental Protection License stipulated by CEA (Central Environmental Authority), has been refused due to non-compliance.

2. OUTLINE OF THE PILOT SURVEY FOR DISSEMINATING SME'S TECHNOLOGIES

(1) Purpose

1) To provide a solution to the MILCO Digana Factory's wastewater effluent quality to meet environmental standards through demonstrating full merits of Ozone Oxidation Method Using Swirling Jet;

2) To enhance developing human resources of water quality control through Huens' providing training and practical assistance to Sri Lankan industry personnel in Japan so that the MILCO Digana Factory's capabilities of operation and maintenance for wastewater treatment can be improved and maintained; and

3) To develop an implementation plan to disseminate Ozone Oxidation Method Using Swirling Jet in various fields and to establish its business in the country.

(2) Activities

1) Verification of the wastewater treatment technology

1-1) Data gathering and analysis of wastewater treatment of the effluent from

MILCO Digana Factory, Kandy for the best design of wastewater treatment system.

1-2) Basic and detailed design of the wastewater treatment system.

1-3) Ordering, manufacturing and transportation of the system's plant and equipment.

1-4) Installation and tune-up of the system at MILCO Digana Factory.

1-5) Evaluation and planning of mitigation and monitoring for environmental and social considerations. In addition, Huens obtained the services of an environmental expert in Sri Lanka from a Sri Lankan University to advise on local conditions.

1-6) Test run and performance review of the wastewater treatment system.

1-7) Monitoring to ensure meeting environmental standards.

1-8) Adjustments of the system based on monitoring and performance review.

1-9) Confirmation of the comparative superiority of the technologies of wastewater treatment by Huens through the investigation.

2) Staff Capabilities Enhancement

2-1) Formulation of operation & maintenance manual for proper and continuous use of the plant and equipment.

2-2) On-site guidance in accordance with the above manual.

2-3) Implementation of operation & maintenance training in Japan for enhancing the capacity of Ministry of Rural Economic Affairs and other stakeholders and understanding Japanese environmental guidelines for discharged wastewater.

3) Wastewater System Enhancement

3-1) Investigation of wastewater treatment legislation and needs, current status of sludge treatment and disposal, power supply condition, subsidized programs etc. in Sri Lanka.

3-2) Business promotion meetings with prospective clients, to demonstrate the advanced technologies by the introduced wastewater treatment system.

3-3) Proposition of the wastewater treatment system to potential purchasers to encourage investment and the dissemination of technology.

3-4) Formulation of Business plan based on the above disseminated activities.

4) Environmental and Social Considerations

4-1) Determination of the items to be investigated at the initial visit in accordance with the Environmental Checklist.

4-2) Data gathering and analysis based on the determined items.

(3) Information of Product/ Technology to be Provided

The technology "Ozone Oxidation Method Using Swirling Jet"(patent technology) developed by Huens of Japan, with which it is possible to treat wastewater with highest efficiency and more energy-saving than conventional method, is proposed to be added to the existing wastewater treatment system. This new additional technology is able to be connected to the existing system between the Anaerobic Tank and the Facultative Pond at MILCO Digana Factory.

(4) Counterpart Organization

MILCO (pvt) Ltd. as a counterpart organization

Central Environmental Authority (CEA) as a facilitator/monitoring agency.

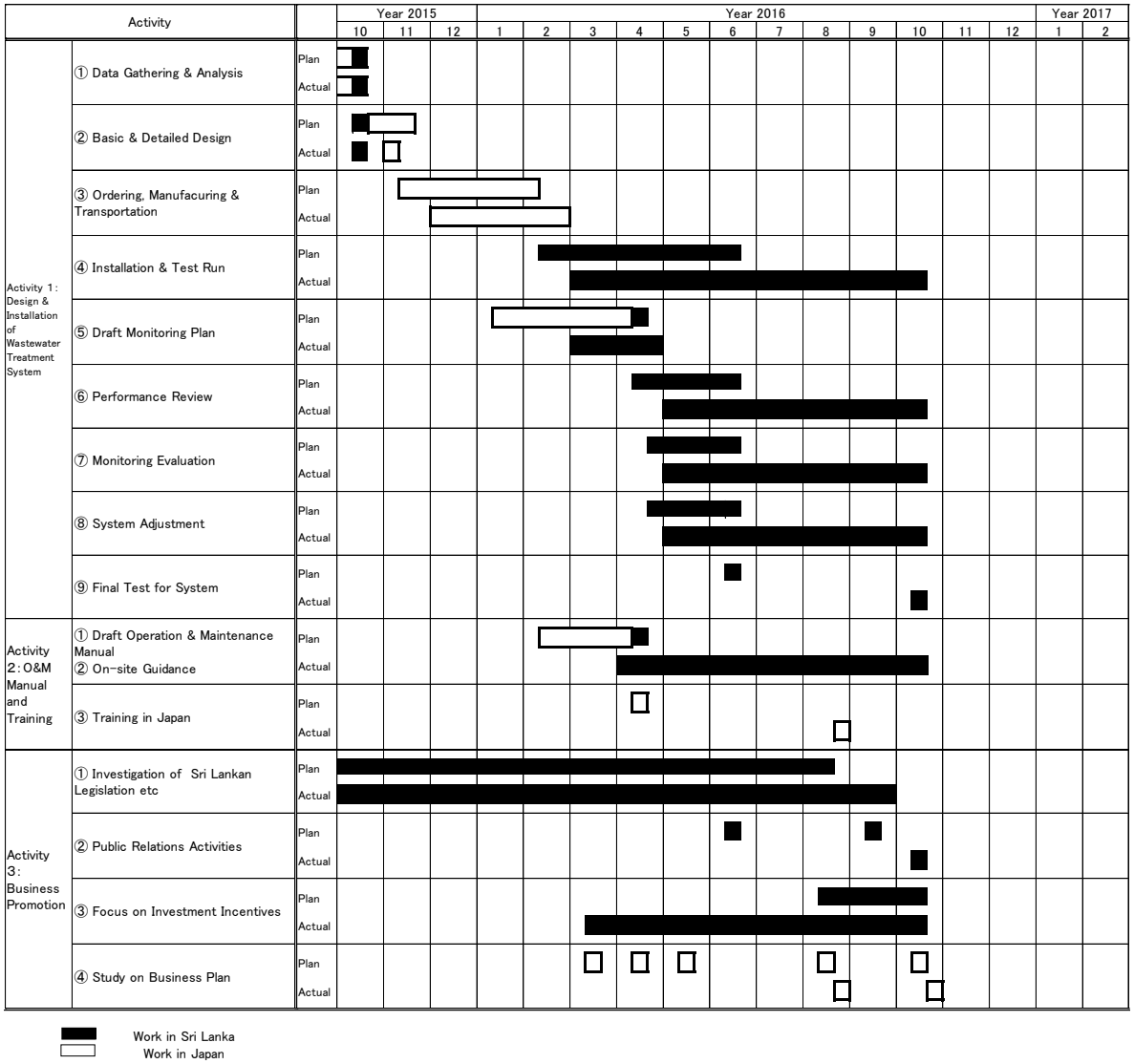
(5) Target Area and Beneficiaries

MILCO Factory at Digana and its surrounding area, Factory management and workers, and the local residents and downstream users influenced by the Factory's discharged water.

(6) Duration

October 2015 to February 2017, 1 year and 5 months.

(7) Progress Schedule



【Overseas Work】

Name	Assignment	Company	Class		No. of Visits	Project Period: Year 2015 10	11	12	Year 2016 1	2	3	4	5	6	7	8	9	10	11	12	Yesr 2017 1	2	3	Working Days (Plan)	Working Days (Actual)	Man Month Total (Plan)	Man Month Total (Actual)
Shitara	Leader	Huens	Z	Plan	2	(7days)								(7days)										14		0.47	
			Z	Actual	2	10/20-25 (6days)												10/18-22 (5days)							11		0.37
Gyakushi	Design & Performance Review 2	Huens	Z	Plan																				0		0.00	
			Z	Actual	1													10/17-22 (6days)							6		0.20
Nakahata	Design/Installation/Test Run	Huens	Z	Plan	2	(7days)				(21days)														28		0.93	
			Z	Actual	4	10/21-24 (4days)				2/29 (1day)	3/1-27 (17days) (10days)				7/17-28 (2days) (10days)			10/17-22 (6days)							38		1.27
Ka (Nishigai)	Installation & Test Run 1	Huens	Z	Plan	3					(21days)			(7days)	(7days)										35		1.17	
			Z	Actual	2						3/21-31 (8days) (3days)	4/1-2 (2days)	5/29-31 (3days)	6/1-9 (5days) (4days)											16		0.53
Jinbo	Installation & Test Run 2	Huens	Z	Plan	1							(7days)												7		0.23	
			Z	Actual	2							4/17-28 (12days)						10/10-22 (13days)							25		0.83
Chiba	Business Promotion 1	Huens	Z	Plan	3	(7days)								(7days)			(7days)							21		0.70	
			Z	Actual	2	10/21-25 (5days)												10/17-22 (6days)							11		0.37
Tsujimoto	Chief Advisor／Environmental & Social Considerations	Kumagai	A	Plan	6	(7days)				(28days)		(7days)	(7days)	(7days)			(7days)							63		2.10	
			A	Actual	5	10/21-25 (5days)				2/29 (1day)	3/1-27 (27days)	4/17-28 (12days)			7/17-28 (12days)			10/10-22 (6days) (7days)							63		2.10
Naito	Business Promotion 2	Kumagai	A	Plan	2	(7days)								(7days)										14		0.47	
			A	Actual	3	10/21-25 (5days)				2/29 (1day)	3/1-20 (9days) (11days)							10/10-22 (6days) (7days)							21		0.70
Ichinose	Finance & Accunting	Kumagai (Hong Kong)	A	Plan	1									(7days)										7		0.23	
			A	Actual	0																				0		0.00
Naito	Business Promotion 3	Other Consultant	A	Plan	1									(7days)										7		0.23	
			A	Actual	0																				0		0.00
Upali (Local)	Investigation & Analysis	Kumagai (Colombo)	A	Plan	4	(3days)				(8days)				(3days)			(3days)							17		0.57	
			A	Actual	3	10/13, 22-23 (3days)		12/23 (1day)	1/27 (1day)	2/12, 23 (2days)	3/1-5, 8-10, 16-17, 23-24, 31 (10days) (3days)	4/1, 7, 26-27 (4days)	5/4, 12-13, 18, 25, 30-31 (7days)	6/7-8, 16, 30 (4days)	7/7, 13, 18-19, 22, 26 (6days)	8/4, 11, 21-27, 31 (10days)	9/1、29 (2day)	10/5, 8, 11, 20 (4days)	11/8, 23 (2days)					10		0.33
Tami (Local)	Information & Analysis	Kumagai (Colombo)	A	Plan	3	(3days)								(3days)			(3days)							9		0.30	
			A	Actual	4	10/13, 22-23 (3days)		12/23 (1day)	1/27 (1day)	2/12 (1day)	3/1-3, 31 (4days)	4/1 (1day)	5/30-31 (2days)	6/7-8, 16 (2days) (1day)				10/19-20 (2days)							9		0.30
Saeki	Business Promotion 5	Other Consultant	B	Plan																						0.00	
			B	Actual	1													10/16-22 (7日)							7		0.23
Sato	Business Promotion 4	Other Consultant	B	Plan	3	(7days)								(7days)			(7days)							21		0.70	
			B	Actual	1	10/21-25 (5days)																			5		0.17

※Takahashi, Kawano, Maruyama and Oba are not listed on the above as they are only for Domestic Work.

	Plan Days	Actual Days	Plan MM	Actual MM
A Toal	117	103	3.90	3.43
B Total	21	12	0.70	0.40
C Total	0	0	0.00	0.00
Total	138	115	4.60	3.83

Overseas Work Subtotal				
	Plan	243		8.10	
	Actual		222		7.40
Consultants Overseas Work Subtotal	Plan	138		4.60	
	Actual		115		3.83

【Domestic Work】

Name	Assignment	Company	Class		No. of Visits	Project Period: Year 2015 10	Year 2015 11	Year 2015 12	Year 2016 1	Year 2016 2	Year 2016 3	Year 2016 4	Year 2016 5	Year 2016 6	Year 2016 7	Year 2016 8	Year 2016 9	Year 2016 10	Year 2016 11	Year 2016 12	Year 2017 1	Year 2017 2	Year 2017 3	Working Days (Plan)	Working Days (Actual)	Man Month Total (Plan)	Man Month Total (Actual)
Shitara	Leader	Huens	Z	Plan		(12days)	(10, 2days)	(2days)	(2days)	(2days)	(3days)	(3days)	(3days)		(2days)	(2days)	(2days)	(4days)	(4days)	(4days)				57		2.85	
			Z	Actual		10/3, 5-7, 13, 19, 26 (5days)	11/2,9,10,16 (4days)	12/14, 28 (2days)	1/25 (1day)	2/15 (1day)	3/1, 11, 14, 25 (4days)	4/4, 25 (2days)	5/6, 13, 30 (3days)	6/6, 20 (2days)	7/11, 25 (2days)	8/8, 29 (2days)	9/14, 26 (2days)		11/2, 7, 24, 28 (4days)	12/5, 13, 19, 26 (4days)					38		1.90
Takahashi	Design	Huens	Z	Plan		(10days)	(10days)																	20		1.00	
			Z	Actual		10/3, 5, 13-15, 17, 19, 20, 26-31 (14days)	11/2, 4-7, 9-14, 16 (12days)				3/12、14-18、28-29 (8days)					8/24 (1day)								35		1.75
Kawano	Design & Performance Review 1	Huens	Z	Plan		(10days)	(10days)																	20		1.00	
			Z	Actual		10/3, 5, 13-15, 17, 19, 20, 26-31 (14days)	11/2, 4, 5, 7, 9-14, 16 (11days)				3/14-18、28-29 (7days)					8/22 (1day)								33		1.65
Gyakushi	Design & Performance Review 2	Huens	Z	Plan		(10days)	(10days)																	20		1.00	
			Z	Actual		10/3, 5, 13-15, 17, 19, 20, 26-31 (14days)	11/2, 4-7, 9-14 (11days)				3/14-18, 28-29 (7days)					8/22-23 (2days)								34		1.70
Nakahata	Design/Installation/Test Run	Huens	Z	Plan		(12days)	(10, 2days)																	24		1.20	
			Z	Actual		10/3, 5, 13-15, 19, 20, 26-31 (13days)	11/2, 4-6, 9-11, 16 (8days)				3/28-31 (4days)													25		1.25
Ka (Nishigai)	Installation & Test Run 1	Huens	Z	Plan		(2days)	(2days)																	4		0.20	
			Z	Actual												8/26 (1day)								1		0.05
Jinbo	Installation & Test Run 2	Huens	Z	Plan							(2days)		(2days)											4		0.20	
			Z	Actual								4/16 (1day)				8/22-26 (5days)								6		0.30
Chiba	Business Promotion 1	Huens	Z	Plan		(2days)	(2days)					(7days)	(2days)					(2days)	(2days)	(2days)				19		0.95	
			Z	Actual		10/6-7 (2days)		12/14, 28 (2days)	1/18 (1day)	2/15 (1day)	3/1, 11, 25 (3days)	4/4, 5 (2days)	5/13, 30 (2days)	6/6, 20 (2days)	7/11, 25 (2days)	8/22-26 (5days)	9/14, 26 (2days)		11/2, 28 (2days)	12/5, 26 (2days)				28		1.40
Tsujimoto	Chief Advisor／Environmental & Social Considerations	Kumagai	A	Plan		(4days)	(5days)	(5days)	(5days)		(2days)				(2days)	(2days)		(7days)	(5days)	(7days)				44		2.20	
			A	Actual		10/6, 7, 11, 12, 15-17, 29 (8days)	11/6, 9, 18-20, 29 (6days)	12/3, 9, 11, 14, 16, 18, 21, 28 (8days)	1/7, 12, 14, 26, 29 (5days)	2/1, 8, 11, 16, 19, 21, 27 (7days)		4/1, 2, 4, 6, 9, 12 (6days)	5/7, 8, 9, 13, 18, 21, 22, 25, 26 (4days) (5days)	6/1, 3, 4, 11, 12, 15, 16, 20, 28 (9days)	7/1, 6, 8, 14, 31 (5days)	8/11, 12, 22-29 (10days)	9/4, 6, 7, 11, 14, 19, 28 (7days)		11/1, 5, 10, 13, 17 (5days)	12/1, 5, 12, 13, 16, 20, 26 (7days)				44		2.20
Naito	Business Promotion 2	Kumagai	A	Plan		(4days)					(2days)	(2days)	(2days)				(2days)	(2days)	(2days)	(2days)				18		0.90	
			A	Actual		10/6, 7, 29, 30 (4days)	11/17, 20 (2days)	12/3, 28 (2days)	1/20, 26 (2days)	2/1 (1day)		4/19 (1day)	5/18 (1day)			8/22-26 (5days)	9/14 (1day)							18		0.90
Naito	Business Promotion 3	Other Consultant	A	Plan		(4days)												(2days)						6		0.30	
			A	Actual																				0		0.00
Upali (Local)	Investigation & Analysis	Kumagai (Colombo)	A	Plan		(7days)	(5days)	(5days)	(5days)	(20days)		(5days)	(5days)	(2days)	(5days)	(5days)	(2days)	(5days)	(10days)	(5days)				86		4.30	
			A	Actual		10/20, 21, 24, 28, 29 (5days)	11/5, 12, 18 (3days)	12/3, 10, 17, 29 (4days)	1/6, 20, 25, 27, 29 (5days)	2/3, 5, 10, 11, 16-18, 24-26, 29 (11days)	3/7, 11, 14, 15, 18, 19, 21, 22, 25, 28-30 (12days)	4/2, 4-6, 15, 18, 19 (7days)	5/7, 14, 17, 19, 26 (6days)	6/3, 6, 10, 15, 21 (5days)	7/6, 11, 14, 20, 25 (5days)	8/2, 10, 15, 19 (4days)	9/2, 12, 19, 23, 28 (5days)	10/4, 7, 10, 14, 19 (5days)	11/7, 17, 24, 28, 29 (5days)	12/2, 6, 14, 20, 25 (5days)				86		4.30
Tami (Local)	Information & Analysis	Kumagai (Colombo)	A	Plan		(7days)	(5days)	(5days)	(5days)	(5days)	(5days)	(5days)	(5days)	(2days)	(5days)	(5days)	(2days)	(5days)	(10days)	(5days)				76		3.80	
			A	Actual		10/2, 14, 16, 20, 24, 26 (7days)	11/9, 13, 17, 18, 20, 24 (6days)	12/10, 11, 14, 16, 18 (5days)	1/8, 10, 14, 28, 29 (5days)	2/2, 5, 8-10, 15, 16, 19, 23 (9days)	3/14, 21 (2days)	4/11 (1day)	5/2, 3, 26 (3days)	6/9 (1day)	7/7 (1day)	8/2, 5, 9, 12, 18 (5days)	9/6, 9, 16, 21, 26 (5days)	10/7, 13, 14, 18, 21 (5days)	11/8, 18, 21, 23, 28 (5days)	12/5, 9, 14, 20, 25 (5days)				65		3.25
Maruyama	Local Alliance 1	Other Consultant	B	Plan		(2days)					(2days)	(2days)	(2days)											8		0.40	
			B	Actual		10/6-7 (2days)										8/22-23 (2days)								4		0.20
Oba	Local Alliance 2	Other Consultant	C	Plan		(2days)					(2days)	(2days)	(2days)											8		0.40	
			C	Actual		10/6-7 (2days)										8/23-24 (2days)								4		0.20
Sato	Business Promotion 4	Other Consultant	B	Plan		(2days)												(2days)						4		0.20	
			B	Actual		10/6-7 (2days)																		2		0.10

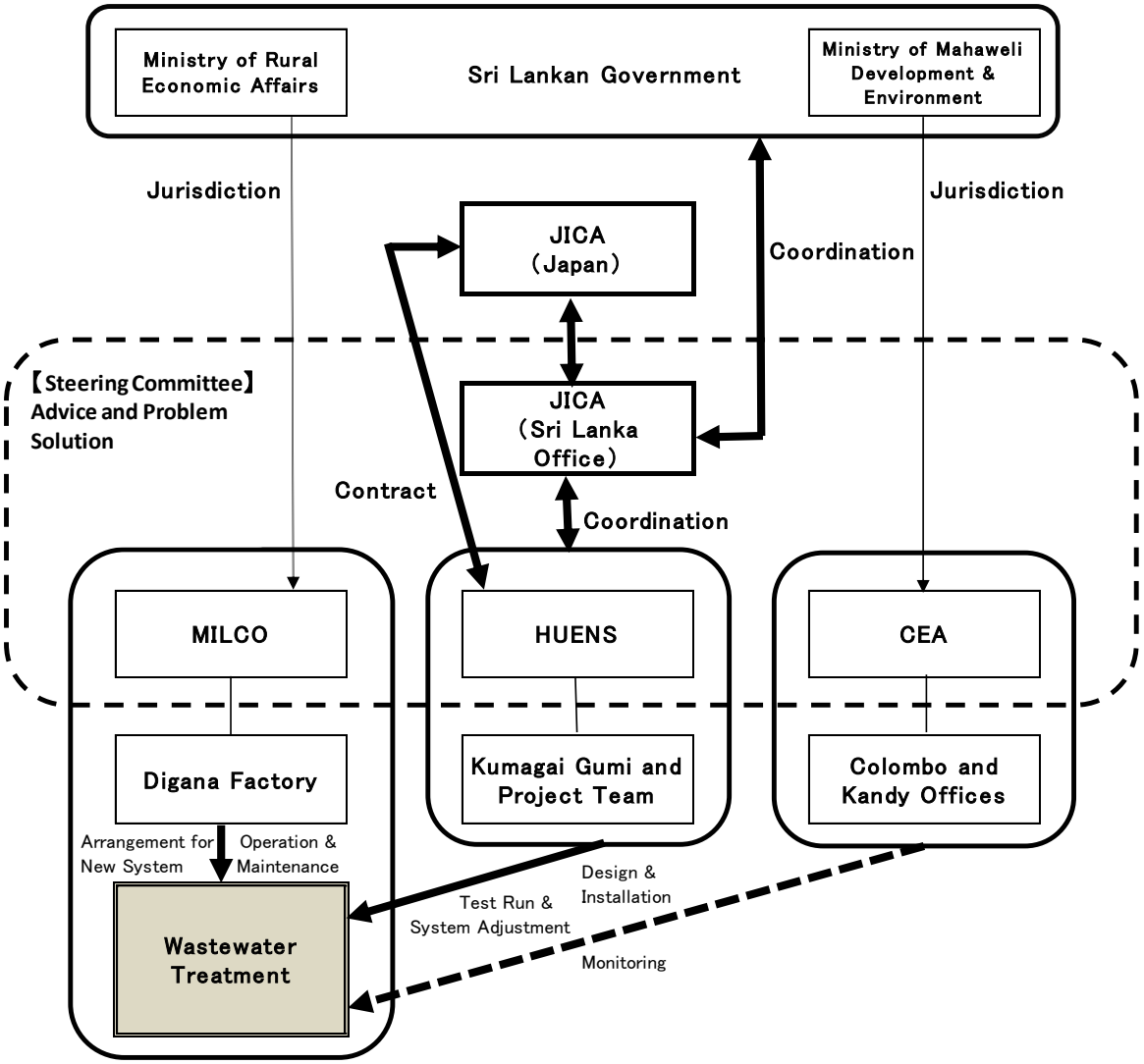
※Ichinose is not listed on the above as he is only for Overseas Work.

Notes : Actual ━━━ Plan ━━━ Out-of-Pocket ━━━

	Plan Days	Actual Days	Plan MM	Actual MM
A Toal	230	213	11.50	10.65
B Total	12	6	0.60	0.30
C Total	8	4	0.40	0.20
Total	250	223	12.50	11.15

		Working Days (Plan)	Working Days (Actual)	Man Month Total (Plan)	Man Month Total (Actual)
Domestic Work Subtotal	Plan	418		20.90	
	Actual		423		21.15
Consultants Domestic Work Subtotal	Plan	250		12.50	
	Actual		223		11.15
Overseas & Domestic Total	Plan	661		29.00	
	Actual		645		28.55
Consultants Total	Plan	388		17.10	
	Actual		338		14.98

(9) Implementation System



3. ACHIEVEMENT OF THE SURVEY

(1) Outputs and Outcomes of the Survey

1) Introduction

The wastewater treatment facility at Milco Factory Digana was upgraded by modifying its existed system replacing the anaerobic pond unit with an ozone oxidation unit coupled with a balancing tank and an activated sludge treatment stage to enhance the overall performance of the system.

After completing the construction works during February and March 2016, the new upgraded system started its operations in April 2016 with the introduction of wastewater into the balancing tank, ozonation unit and the activated sludge system.

Additions to the modified system included a new screen, a new grease trap, a new ozonation unit with a new balancing tank, and a new activated sludge system (Figure 1). The system is operated in such a way that only a part of incoming wastewater is treated with the ozonation unit and activated sludge system, and the rest is allowed to overflow from the balancing tank into the facultative pond and then to the aerobic pond for further treatment.

The test-run and monitoring of the system for the inflow and the treatment efficiency was started in April 2016 and is continued until November 2016.

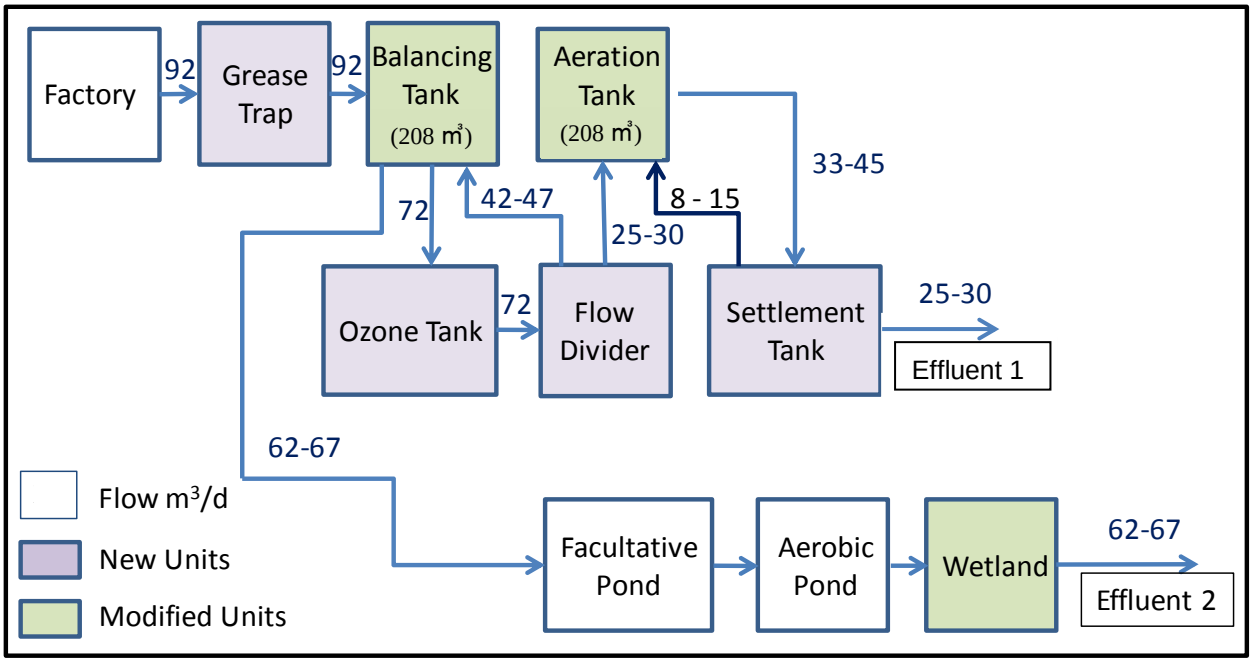


Figure 1: Schematic Diagram and Operational Data of the Modified Wastewater System

2) Basic Operational Data

2-1) Flow Rates

The monitoring from May 2016 with two new magnetic flow meters installed shows average wastewater generation at the factory around 60 to 97 m3/d (Average 77) with the high and low being 147 m3/d and 28 m3/d respectively. This rate was 80% more than the designed values and nearly double the 49 m3/d flow rate observed in January 2016. This increase in inflow is believed to come from the newly installed UHT plant at the factory. The average flow records since 1 May 2016 to 5 November 2016 are shown in Table 1.

Table 1: Average Flow Data in cubic meters a day

Period	Out Eqn Tank	Out Set Tank	Total Out
Flow Estimation in January 2016			25 to 60
1 May to 7 May	55	17	72
8 May to 14 May	63	29	92
15 May to 21 May	52	21	73
22 May to 28 May	45	24	69
29 May to 2 June	75	9	84
7 June to 11 June	89	8	97
12 June to 18 June	77	10	87
19 June to 25 June	80	13	93
26 June to 2 July	82	13	95
3 July to 9 July	80	16	96
10 July to 16 July	79	15	94
17 July to 23 July	46	30	76
24 July to 25 July	38	22	60
27 July to 30 July	62	17	79
31 July to 6 August	54	19	73
7 August to 13 August	51	30	81
14 August to 20 August	62	10	72
21 August to 27 August	68	11	79
28 August to 3 September	65	15	80
4 September to 10 September	57	21	78
11 September to 17 September	41	32	73
18 September to 24 September	43	34	77
25 September to 1 October	50	25	75
2 October to 8 October	75	8	83
9 October to 15 October	50	16	66
16 October to 22 October	58	20	78
23 October to 29 October	46	29	75
30 October to 5 November	34	34	68

Though the initial wastewater flow expected was around 50 m3/d, to accommodate the increased wastewater flow due to the addition of an UHT plant, the system was modified to be operated at around 92 m3/d. With the

input to the Ozonation unit of around 72 m3/d, the wastewater volume processed through the activated sludge system was around 25 to 30 m3/d as shown in Figure 1.

The data shows that the activated sludge system operated at around 34 m3/d in the last week of October 2016.

2-2) Wastewater Quality and Operational Records

The 5-day BOD (Biochemical Oxidation Demand), COD (Chemical Oxidation Demand), TSS (Total Suspended Solids) variations during the period (since 2 September 2013 until 8 November 2016) are shown in Tables 2, 3 and 4 respectively. All these data tables (after test-run starts) are prepared based on the tests carried out at the CEA Kandy Laboratory.

Table 2: BOD variation in mg/l

Date	Eqn	Aeration	Ozone	Final
2 September 2013	225			
12 August2014	65			
5 June2015	627			
7 April2016	1,080	761	576	318
After Test-run Starts				
27 April	1,656	213		27
5 May	2,569	243		20
12 May	1,398	912		328
18 May	3,040	881		506
25 May	1,687	255		231
8 June				17
16 June	2,097			3
23 June	1,884		1,915	19
30 June	2,553			6
7 July	1,763		2,097	9
13 July			1,520	11
21 July	1,946		1,763	16
4 August	2,584		2,766	140
11 August	1,505		1,824	76
15 August	720			255

23 August				12
31 August	2,006		1,946	6
6 September				21
15 September				13
23 September				444
30 September				426
7 October				78
8 November				10
CEA Guideline				**30**

Table 3: COD variation in mg/l

Date	Inlet	Eqn	Aeration	Ozone	Final	Facultative
2 September 2013	1,800					
12 August 2014	468					
5 June 2015	943					
7 April 2016		9,740	10,270	7,240	4,480	
After Test-run Starts						
27 April	6,785	4,107	2,499	3,928	286	
5 May	6,546	3,637	2,182	4,000	127	
12 May	8,848	1,770	1,062	3,362	619	
18 May	1.391	4,174	3,826	2,783	678	
25 May	6,261	3,826	1,044	3,476	1,044	
31 May	1,695	3,390	3,729	2,712		
8 June		3,362			98	1,960
16 June		4,000		3,000	60	2,800
23 June		4,400		4,000	140	2,600
30 June		4,200		3,600	60	2,800
7 July		3,960		3,960	99	2,376
13 July		3,018		3,018	94	
21 July		5,926		6,482	56	3,519
4 August		4,074	2,760	3,704	296	2,778
11 August		3,689		3,495	971	1,670
15 August		3,495		2,718	777	1,553
23 August		5,965		1,930	88	
31 August		3,600		3,400	120	2,200

6 September		4,000		3,200	80	2,000
15 September		4,800			58	2,496
23 September		4,224		4,416	2,304	2,112
30 September		4,992			1,152	2,304
7 October		5,000			192	2,692
8 November					31	
CEA Guideline					**250**	

Table 4: TSS variation in mg/l

Date	Eqn	Aeration	Final	Facultative
2 September2013	119			
12 August2014	164			
5 June 2015				
7 April2016				
After Test-run Starts				
27 April	1,245	1,164	25	
5 May	1,200	1,490	25	
12 May	600	2,260	62	
18 May	600	1,270	250	
25 May	808	430	220	
8 June				
16 June	580	1,800	1	660
23 June		1,344	30	58
30 June		1,430	12	
7 July		1,350	27	2,376
13 July		850	29	
21 July		1,885	26	
4 August			71	
11 August		1,100	440	
15 August		3,400	210	150
23 August		2,410	5	
31 August		2,150	23	
6 September		1,920	2	
15 September		2,700	8	
23 September		2,800	1,000	

30 September		3,304	180	
7 October		3,900	96	
8 November		2,800		
CEA Guideline			**50**	

Initially the system was operated to run the equalization tank and the ozonation unit until the aerobic reactor was acclimatized to achieve desired MLSS levels. Once the MLSS level had been at acceptable range, the wastewater was gradually introduced to the aerobic reactor to reach around 15 m3/d flow by the end of April 2016. However, a shock loading event in and around 6 May (according to flow data inflow increased from 15 m3/d to 36 m3/d) disturbed the aerobic reactor operations leading to a sludge bulking event prompting to reduce the inflow to around 25 m3/d by 13 May 2016. This change reduced the sludge bulking but the reactor did not recover its MLSS concentration (reducing from 2260 mg/l on 12 May to 430 mg/l on 25 May) to desired levels. Then the inflow to the reactor was stopped on 1 June 2016 to allow the MLSS in the reactor to recover. Once the reactor MLSS showed some improvement again, wastewater was introduced to the reactor at around 10 to 12 m3/d. Though those adjustments were needed three times during test running, the system gradually increased feed rate to the activated sludge reactor and is now running at the condition of 30-35 m3/d.

During the test-run period from April to October 2016, the system was operated at various flow combinations to optimize the use of treatment units especially the activated sludge component. Though the activated sludge system was originally designed for a flow rate of 25 m3/d, flow through the activated system was varied from 20 m3/d to 45 m3/d. Increasing flow rate beyond 30 m3/d into the activated sludge system, though it did not alter the good settling characteristics of sludge, unstable conditions at the sedimentation unit prevented from doing so. Therefore the final operational sequence proposed is set at 30-35 m3/d.

In the meantime the MILCO staff is now becoming conversant with the operation of the plant with the varying conditions. They are capable of handling problematic situations with the experience gained over the last few months. This is very encouraging as there was very little interest MILCO had in respect of wastewater treatment prior to this project.

Reactor MLSS in the activated system was monitored throughout the

test-run period to assess the performance of the unit. The MLSS in the activated sludge reactor was stable on most of the time but became low in few instances after unstable conditions observed at the sedimentation tank washing out sludge.

The system as shown in Figure 1 has two effluent streams; one stream running through the activated sludge system and the other stream running through the stabilization pond units. The treated water quality from the activated sludge system (Effluent 1) showed excellent COD, BOD and TSS removal. The effluent COD, BOD and TSS from the activated sludge system during stable conditions were in the ranges of 31 to 99 mg/l, 6 to 21 mg/l and 2 to 29 mg/l respectively well within the CEA Guidelines.

The average Removal Ratios of BOD and COD are 92.5% and 90.3% respectively from 25 April 2016 to 31 August 2016, and the ability of the ozonation unit proved to be satisfactory.

2-3) System Status and Summary

The present running mode can be described as 28-35 m3/d treated with the ozonation and aerobic stage, and the rest (around 30 to 40 m3/d) partially treated with the ozonation unit is released into the facultative pond system. This mode of operation achieved the desired treatment levels, and the overall COD at the end of the combined system met the CEA Guideline.

Further the aerator capacity was improved at the aerobic pond with the addition of a unit and the wetland unit was completely re-done in October 2016 to improve the overall treated water quality at Effluent 2.

With the modifications to the stabilization pond system the COD and TSS from of Effluent 2 were improved to 203 mg/l and 80 mg/l respectively by 8 November 2016. This latest effluent levels gives an overall combined COD and TSS of around 150 mg/l and TSS around 50 mg/l to meet the CEA Guidelines.

With the wetland unit still to fully mature and the aeration capacity in the aerobic pond to improve further in the near future the Effluent 2 is expected to improve further to give a much better combined final effluent. It is noted here that even the activated reactor can accommodate much higher inflow.

(2) Self-reliant and Continual Activities to be Conducted by Counterpart Organization

This system is expected to improve further with the following recommendations.

1) To further optimize the activated sludge unit to increase flow through it to reach a value of around 40 to 45 m3/d. This may warrant improvements to the existing sedimentation unit and to regularize the waste sludge withdrawals.
2) To maintain the aerations at the aerobic pond at required levels.
3) To protect the wetland unit against damage. This protection is essential for the full maturation of the wetland unit.
4) To monitor regularly the effluents, reactor MLSS, sludge characteristics and performance of the ozonation unit and correct if any deficiency is observed in accordance with Operation & Maintenance Manual.
5) To monitor and add if required waste removal enhancing agent such as QUICK 2 to maintain the effluent quality.
6) To agree on a operation and maintenance plan with consultants to maintain the treatment plant.

4. FUTURE PROSPECTS

(1) Impact and Effect on the Concerned Development Issues through Business Development of the Product/ Technology in the Surveyed Country

It is demonstrated that Huens' technology provides competitive advantages over conventional plants in many ways.

1) Land requirement is much less, hence it can be set-up in a small area where the land is limited.
2) Technology is not labor intensive but highly efficient and thus is economical and attractive with lower operational and maintenance costs.
3) The system is not only suitable for new installations but also can easily be used to enhance the treatment efficiency of existing units with minimal space and effort.
4) This system not only controls BOD and COD levels efficiently but also eliminates the odor and reduces sludge generations making it attractive for many industries including the hotel sector.
5) Overall it is a smaller environmental footprint

With the above advantages, the business opportunity exists mainly in two areas; one is replacement for old and mal-functioning existing wastewater treatment plants, and the other is for new factories and government sector.

(2) Lessons Learned and Recommendation through the Survey

1) It is very important to gather accurate information, make analysis and monitor the

performance to maximize the benefits from the new system.

2) Continuous efforts of daily check & cleaning and regular maintenance are highly recommended.
3) A team of capable operators is required to run the system in the proper and continuous use.

ATTACHMENT: OUTLINE OF THE SURVEY

Sri Lanka

Verification Survey with the Private Sector for Disseminating Japanese technologies for Wastewater Treatment by Ozone Oxidation Method with Swirling Jet
Huens Co., ltd., Hokkaido, Japan

Concerned Development Issues in Sri Lanka

- Significant environmental pollution from rapid population growth and economic development
- Huge Potential for Wastewater Treatment Due to Lack Proper Wastewater Treatment Systems

Implemented Activities in the Survey

- Wastewater treatment by Ozone Oxidation Method Using Swirling Jet connected to existing wastewater system to improve wastewater effluent quality to meet environmental standards
- Formulate an operation & maintenance manual for proper and continuous use of the plant and equipment

Proposed Products/Technologies

Product/Technology
- Ozone Oxidation Method Using Swirling Jet (Patent Technology)
- Highest Efficiency and More Energy-saving
- Environmentally Friendly Way of Wastewater Treatment

Survey Overview

Name of Counterpart:
MILCO (Pvt) Ltd.
Survey duration:
Oct 2015 to Feb 2017
Survey Area:
MILCO Factory at Digana, Kandy, Sri Lanka

Impact on the Concerned Development Issues in Sri Lanka

- To meet environment standards
- To enhance developing human resources of water quality control
- To contribute to create an environmental protection system in both urban and rural areas

Outputs and Outcomes of the Survey

- To enhance the awareness and knowledge among the Sri Lankan environmentalists and other professionals on the use of advanced technology (Ozone Oxidation Method Using Swirling Jet)
- To disseminate Ozone Oxidation Method Using Swirling Jet in various fields and to establish its business in the country