

Department of Public Works and Transport of
Bolikhamxay Province, NPSE-Bolikhamxay
Department of Water Supply
/ Ministry of Public Works and Transport

Summary Report

Lao People's Democratic Republic

Verification Survey with the Private Sector for
Disseminating Japanese Technologies
of Water Purification System for Highly Turbid
Water for Use in Small Town Water Supply

April, 2018

Japan International Cooperation Agency

TOHKEMY CORPORATION

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ATTACHMENTS:

- 1) OUTLINE OF THE SURVEY
- 2) ACHIEVEMENT OF THE SURVEY (LAO)

1. BACKGROUND

The government of the Lao PDR has set a national goal of 80% coverage of piped water supply in urban communities by 2020: the coverage ratio as of 2014 remains at 67%. The securing of a “stable supply of safe water” is a critical issue for the promotion of economic growth, urbanization and population increase, as well as for the reduction of regional disparities. One of the policies adopted by the government, the “Small Town Water Supply Service Investment Plan” (Revised Investment Plan for Water Supply Service) has been implemented in Lao PDR since 2013, aiming at the development of an urban water supply in small scattered villages (close to urban areas). However, there is a shortage of good-quality groundwater sources especially in urban areas, so there is a need to purify surface water economically, even though the surface water, such as the Mekong River, is extremely turbid following rainy weather.

Meanwhile, in FY2013 the Joint Study Team (consisting of TOHKEMY Corporation and Pacific Consultants Co., Ltd.) carried out a “Study on the Project Formulation for a Small Town Water Supply System” in Lao PDR, as part of a “Project Formulation Survey” under the Governmental Commission on the Projects for ODA Overseas Economic Cooperation. As a result, it was confirmed that the system and technologies of the Joint Study Team, namely a purification system for very turbid water, might be applicable to the water supply projects listed in the above-mentioned investment plan. At the present time the “Project Formulation Survey”, which had been agreed on in a MOU (Memorandum of Understanding) dated 27th December 2013 between the Department of Housing and Urban Planning, the Ministry of Public Works and Transport of Lao PDR and the Joint Study Team, has been adopted as one of the Verification Surveys with the Private Sector for Disseminating Japanese Technologies, targeting Paksan, Bolikhamxay, a small town in Lao PDR.

Subsequently, MM (Minutes of Meeting) dated 15th May 2015, concerning the Verification Survey with the Private Sector for Disseminating Japanese Technologies of Water Purification System for Highly Turbid Water for Use in Small Town Water Supply (referred to below as "the survey") were signed among the Japan International Cooperation Agency (JICA), TOHKEMY Corporation and the Department of Public Works and Transport (referred to below as the DPWT) of Bolikhamxay Province; and the survey has now been completed.

2. OUTLINE OF THE SURVEY

(1) Purpose

1) Objective

The Survey will improve access to safe water for residents in target areas by introducing a high-turbidity water purifying system in Paksan area of Bolikhamxay, and will contribute to the improvement of living standards and the widespread of the urban water supply. At the same time, the Survey will verify regional adaptability of the water purifying system, and develop a plan to diffuse the system through Lao PDR.

2) Expected Results

Result 1: The adaptability of the water purifying system will be verified and access to safe water will be improved.

Result 2: A plan to diffuse the water purifying system will be formulated.

(2) Activities

Activities related to Result 1:

1-1 Discuss with the local organization concerned and survey the site

1-2 Examine the design and construction plan

1-3 Plan and implement the local procurement

1-4 Manufacture water purification system in Japan

1-5 Transport the water purification system and equipment (Transportation by sea and land)

1-6 Confirm the progress and completion of the part to be implemented by C/P

1-7 Construct the system on-site (installation and test run)

1-8 Prepare the manual of operation and maintenance for “the water purification system”.

1-9 Transfer the technology of operation and maintenance of “the water purification system” to staff of NPSE-Bolikhamxay

1-10 Operate/maintain and monitor the system to verify compatibility (water quality measurement etc.).

Activities related to Result 2:

2-1 Coordinate and negotiate with the local organizations concerned

2-2 PR activities (Workshop, Session etc.)

2-3 Collect Information and interviews with key-persons concerned for the

dissemination

2-4 Formulate a dissemination plan after the completion of this Survey

(3) Information of Product/ Technology to be Provided

1) Water Purification System:

This is a small-scale high-turbidity water purifying system, consisting of fiber filtration equipment for high and medium turbidity, and rapid sand filtration. The system is capable of treating 1,000m³/day high-turbidity surface water (1,000 to 3,000 NTU) under rainy conditions.

2) Principal equipment and specifications:

Treated water capacity: 1,000m³/day

- Up-flow Actifiber filtration unit (AFU1215)φ1200 mm × H3500 mm 2 vessels
- Down-flow Actifiber filtration unit (AFU1615)φ1600 mm × H3900 mm 1vessel
- Sand filtration unit 2600 mm × H4500 mm 1 vessel
- Control panel for water purification system
- Pump (UA、AF、SF、conveying water unit)
- Air blower
- Piping
- Chemical dosing unit (Al₂(SO₄), Chlorine ,Caustic sodium) 4units
- Water analyzer

(4) Counterpart Organization

Japanese Side: TOHKEMY CORPORATION

Lao Side : Department of Public Works and Transport (DPWT) of
Bolikhamxay Province
NPSE-Bolikhamxay
(NPSE : Nam Papa State-owned Enterprises
(Provincial public water suppliers))

<Contact Organizations>

(Until December 2015)

Department of Housing and Urban Planning/Ministry of Public Works and Transport
(After January 2016)

Department of Water Supply/ Ministry of Public Works and Transport

(5) Target Area and Beneficiaries

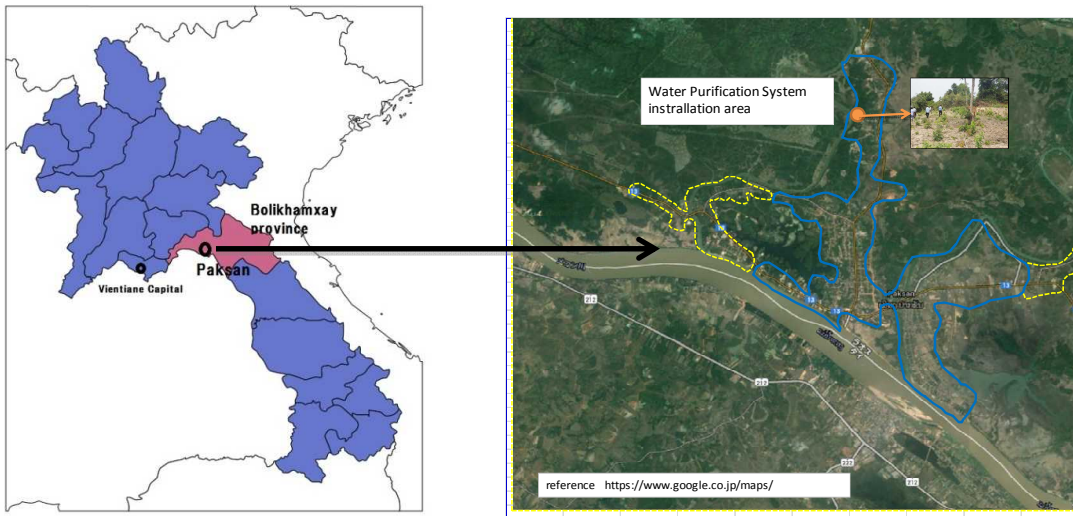


Figure: Site MAP

Target Area (Location of Installation):

Thong Village, Paksan District, Bolikhamxay Province, Lao PDR.

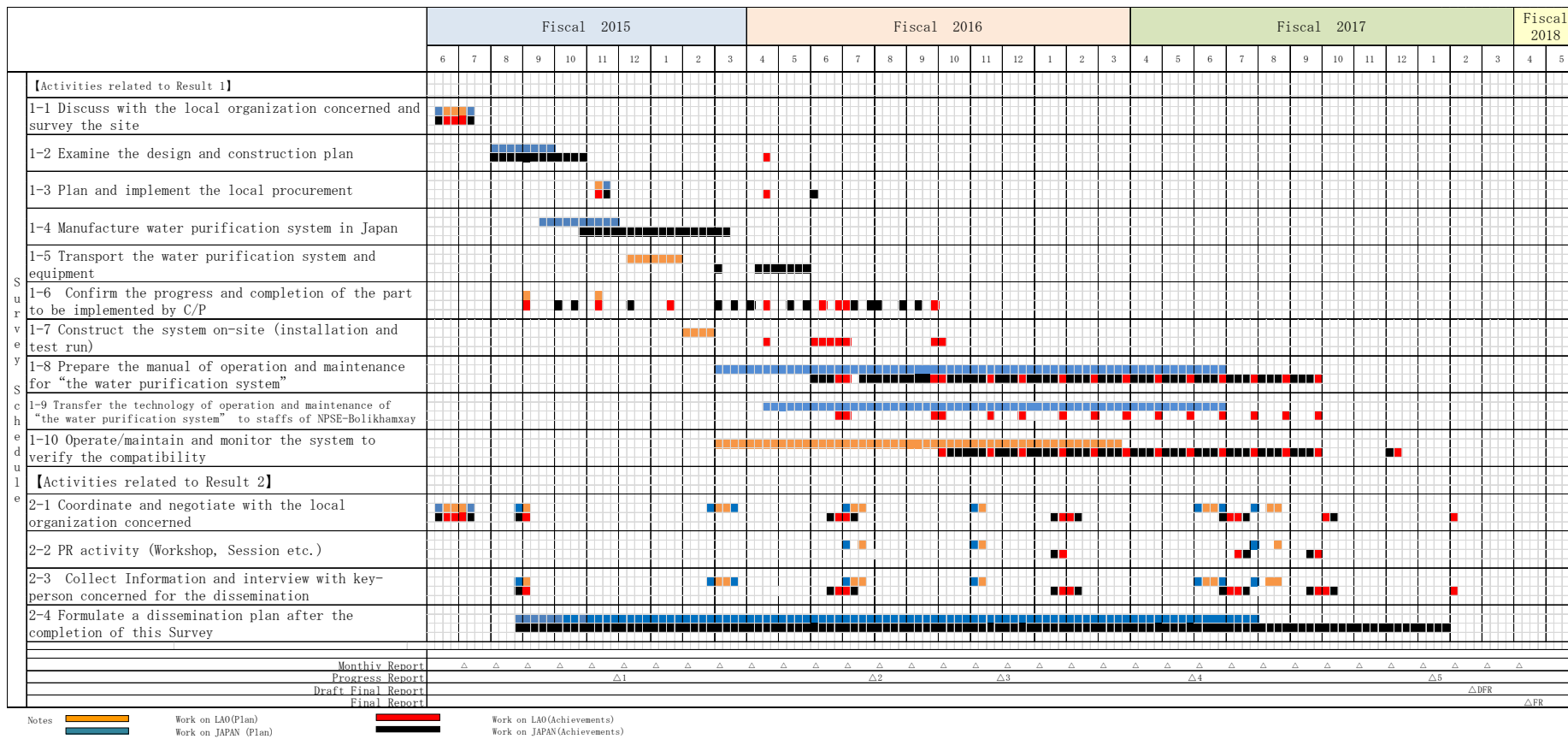
Beneficiaries:

Water supply users: local residents, stores, public facilities in the district served by the water supply system.

(6) Duration

From June, 2015 to May, 2018 (3 years)

(7) Progress Schedule



(8) Manning Schedule

① Manning Schedule (Plan)

Work Assignment	Name	Company Name	Fiscal 2015												Fiscal 2016												Fiscal 2017					Total					
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	LAO	JAPAN			
Project Manager	Takuya HOSOTANI	TOHKEMY CORPORATION			6	6												6														6	10			1.33	
Engineering	Kensaku KOBAYASHI	TOHKEMY CORPORATION			6					5								21																	1.17		
Engineering	Jun HASHIGUCHI	TOHKEMY CORPORATION											14	6	6	6	6	10	6	6	6	6	6	6	6	6	6	6	6	6	6			1.60			
Engineering	Tsutomu OHGAI	TOHKEMY CORPORATION														6			6		6			6			6							0.80			
Engineering	Hideaki TAN	TOHKEMY CORPORATION																10				6												0.80			
Chief Adviser	Tatsuo MORIMOTO	PACIFIC CONSULTANTS CO.,LTD			15					5								10																	2.17	2.35	
																																	TOHKEMY (M・M) =		5.70		
																																	PCKK (M・M) =		2.17	2.35	
																																	Total (M・M) =		7.87	2.35	

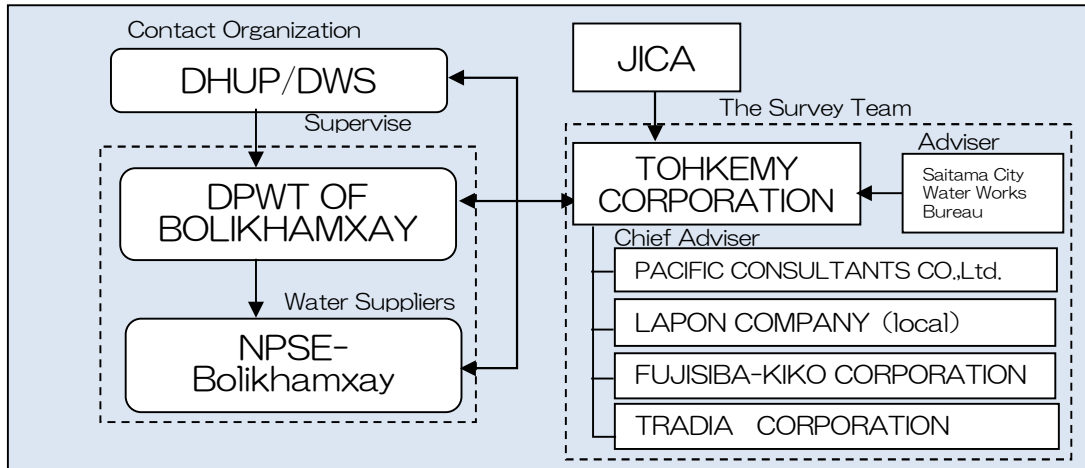
Notes Work on LAO (orange square) Work on JAPAN (blue square)

② Manning Schedule (Achievements)

Work Assignment	Name	Company Name	Fiscal 2015												Fiscal 2016												Fiscal 2017												Fiscal 2018		Total	
			Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Aug	Sep	LAO	JAPAN
Project Manager	Takuya HOSOTANI	TOHKEMY CORPORATION			10	11													2																				1.20	1.95		
Engineering	Kensaku KOBAYASHI	TOHKEMY CORPORATION			10	11				5									24																				3.53	2.75		
Engineering	Jun HASHIGUCHI	TOHKEMY CORPORATION																																				2.80	1.65			
Engineering	Tsutomu OHTANI	TOHKEMY CORPORATION																																					0.00	0.00		
Engineering	Hideaki TAN	TOHKEMY CORPORATION																																					0.00	0.00		
Chief Adviser	Tatsuo MORIMOTO	PACIFIC CONSULTANTS CO.,LTD			15																																	2.17	2.35			
																																	TOHKEMY (M・M) =		7.53	6.35						
																																	PCKK (M・M) =		2.17	2.35						
																																	Total (M・M) =		9.70	8.70						

Notes Work on LAO (red square) Work on JAPAN (black square)

(9) Implementation System



Roles of each organization

Organization	Roles
DPWT OF BOLIKHAMXAY	<ul style="list-style-type: none"> - Secure the budget for civil and building construction to install the water purification system - Support for procedures to install the water purification system - Coordinate the handover of the system from Japanese side to NPSE.
NPSE-Bolikhamxay	<ul style="list-style-type: none"> - Implement the civil and building construction to install the Water Purification system - Support for procedures to install the water purification system - Support for data collection (in regard to water supply utility) - Provide the office space during the survey - Support for measuring and recording data during the survey - Train the engineers to operate the system continuously after the survey - Provide opportunities to present the verification survey and any supports
DHUP and DWS /Ministry of Public Works and Transport	<ul style="list-style-type: none"> - Contact institution of this survey (foreign assistance) - Support for procedures to transport the system and equipment (custom) - Support for data collection (national level) - Supervise the staff members of Lao side
The Survey Team/ TOHKEMY CORPORATION/ Pacific Consultants Co.,LTD. etc	<ul style="list-style-type: none"> - Interview with related organization and site reconnaissance - Design and plan the construction - Plan and implement the procurement in Laos - Manufacture the water purification system in Japan - Transfer the system from Japan to Laos - Confirm the completion of facilities to be installed by Laos side - Construction works (Installation and commissioning of the system) - Provide operation and maintenance manuals - Transfer the technology to maintain and operate the system (to NPSE) - Operation management and water quality monitoring - Formulate a dissemination plan after the “Survey” - Support the implementation of the survey - Coordinate and negotiate with Lao side agencies - Collect information to develop a business roll out and interview with the parties concerned - PR activities (Work shop and seminar) - Support to formulate a plan for dissemination of the system (including market analyze and profitability)

3. ACHIEVEMENT OF THE SURVEY

(1) Achievement of activities related to Result 1:

1-1 Discuss with the local organization concerned and survey the site

- An understanding of the variation in river water quality was gained through interviews with the staff of NPSE-Bolikhamxay.
- Cooperation in a daily inspection of river water quality was arranged.
- A study of the chemical injection rate, etc., was made based on the raw water (river water) turbidity data and the results of water flow testing.

1-2 Examine the design and construction plan

- A design coordination meeting was held with the local NPSE-Bolikhamxay and local construction companies in June, September and November 2015, at which details of construction matters requiring attention were confirmed, adjusted and reviewed.

1-3 Plan and implement the local procurement

- The local materials and equipment were procured in timely manner.

1-4 Manufacture water purification system in Japan

- An order for the materials and equipment to manufacture the water purification system in Japan was placed dated 20th October 2015, after the progress of the local construction plan/work and the completion of the access road to the construction site were confirmed.
- The water purification system and equipment were manufactured in Japan and made a trial run, and checked the operation and performance of each section of the equipment.

1-5 Transport the water purification system and equipment (Transportation by sea and land)

- A meeting was held with the transport company with respect to packing involving checking of the actual items on 3rd March 2016.
- From 11th April of the same year, the water purification system and equipment were sequentially sent to the packing company, and were shipped from Shimizu Port on May 11.
- The equipment was then transported overland from Laem Chabang Port in Thailand, passed through Laos import clearance procedures, and arrived on site 30th May, and installation work was then begun.

1-6 Confirm the progress and completion of the part to be implemented by C/P

- The Survey Team visually checked the progress of the construction work at the site, and kept up with the state of progress by means of photographs of the construction

site taken monthly.

- The water tank, construction of which was reported to be delayed, was completed on 8th September 2016.

1-7 Construct the system on-site (installation and test run)

- Unloading of the equipment began on-site on 3rd August 2016 and completed the next day.
- Equipment installation, piping assembly and electrical work were carried out from the next day, and construction was completed on 17th June 2016 save for the installation of some measuring equipment.
- Japanese experts were dispatched to check the plumbing and electric wiring with the support of local hired workers.
- A test run was carried out starting 20th June 2016 and completed 5th July 2016 with the exception of tests relating to the elevated water tank.
- As for the elevated water tank, installation of the instrumentation device was completed 26th September 2016 and the comprehensive trial run was completed at the end of September.
- A trial run of the system confirmed that the treated water met the water quality standards of Laos.

1-8 Prepare the manual of operation and maintenance for “the water purification system”.

- Confirmation of year-round operation of the system and preparation of an operating and maintenance manual in English to enable the NPSE-Bolikhamxay to use the system properly.

1-9 Transfer the technology of operation and maintenance of “the water purification system” to staff of NPSE-Bolikhamxay

- The technology for operation and maintenance of the system was transferred to three staff members of NPSE-Bolikhamxay, with the prepared manuals.
- Training sessions were provided basically six days per month during the first year monitoring period (from the end of September 2016), and after this period the staff of NPSE-Bolikhamxay started to operate the system by themselves with tele-support by Tohkemy via the Internet and by phone.
- Maintenance service was provided through the cooperation of Lapon Co. Ltd., who is a local partner of TOHKEMY Corporation.

1-10 Operate/maintain and monitor the system to verify compatibility (water quality measurement etc.).

The compatibility was examined by the following steps in order to adapt the water

purification system to the condition of the site.

- i. Commissioning & Coordination: Confirmed that the system operated properly and sequentially.
- ii. Primary test: Checked the performance of all the water purification system including the up-flow filter for high turbidity using measuring equipment and water analyzer.
- iii. Stable operation [Dry season]: Operated the down-flow filter for medium turbidity and the sand filter for low turbidity, and conducted the water purification
- iv. System adjustment [Rainy season]: Operated the up-flow filter for high turbidity purification in order to adapt properly to the condition of rainy season.
- v. Stable operation [Rainy season]: Confirmed that the series of operation is stable by checking the measured data of turbidity.

(2) Achievement of activities related to Result 2:

2-1 Coordinate and negotiate with the local organizations concerned

- The Survey Team held interviews with the C/P (DHUP, NPSE-Bolikhamxay), other related Lao governors and agencies, JICA Laos office and the Japanese Embassy in Lao, to explain the outline and purpose of the survey and coordinate with them for its implementation.

2-2 PR activities (Workshop, Session etc.)

The following events were held to disseminate the water purification system with the consent of the counterparts.

- Presentation and Ceremony to celebrate the completion of the Water Treatment Plant in Paksan.
 - The presentation was held 31st January 2017 together with a ceremony to mark the completion of the water purification system.
 - Approximately, 40 persons attended the Presentation and 110 persons attended the ceremony. During the Q&A session about the equipment, some specific questions were raised, such as questions on the scheme for this survey, product cost, running cost, number of days required for production, and number of administrators. In addition, many local residents who participated in the session expressed their gratitude on being able to use a piped water supply service.
- Presentation at JICA Technical Cooperation Project Seminar.
 - The survey results of the water purification system were presented, and PR was

carried out at the MaWaSu seminar (venue: Vientiane) from 11th to 13th July 2017.(MaWaSu: JICA technical cooperation project)

- The number of participants was approximately 250 .
 - Providing an overview of the survey enabled the participants to gain a greater understanding.
 - The panel display produced expressions of interest and opinions from water supply utilities.
 - People looked forward to the provision of facilities not only in Bolikhamxay province but also in other provinces.
 - The participants learned the name of TOHKEMY.
- Work shop for NPSE-Bolikhamxay and Presentation of the results of verification activities.
- The aim of this workshop was to deepen NPSE-Bolikhamxay staff's understanding of the technical and maintenance aspects of the water purification equipment and to exchange views on what improvements can be made to water purification equipment. It was held in the Conference Room of NPSE-Bolikhamxay on 27th September 2017.
 - The participants were 20 members of staff of NPSE-Bolikhamxay.
 - The Survey Team reported the verification results of site compatibility over 12 months.
 - Through the exchange of views and the workshop, the participants gained a deeper understanding of the technical and maintenance aspects of the water purification system.
- Other effective PR activities
- A panel exhibition describing the survey implementation status was held at the Project MaWaSu 4th International Seminar held in Savannakhet from 16th to 17th November 2016.A total of some 100 persons participated in the Seminar, including water service officials from each of the provinces of Laos and participants from Japan. The Survey Team were asked a lot of questions about the equipment.

2-3 Collect Information and interviews with key-persons concerned for the dissemination

For full-scale expansion, the following studies and interviews were conducted.

- Verification of means of maintaining production quality in Laos
- Examination of business model for dissemination (including risk management)

- Cost benefit analysis
- Suggestions to other organizations such as international and bilateral donors

2-4 Formulate a dissemination plan after the completion of this Survey

- Business possibility was examined in terms of municipal water supply plant for small town in other area and private water supply plant in industrial park and developing zone, and the dissemination plan after the completion of this project was formulated.

【Phase 1: Continuous accumulation of achievements and experiences, and establishment of local structures (2018 - 2020)】

Establishment of a local affiliate as a base for equipment manufacture, sales and maintenance service in Lao PDR. Creation of business alliances with local affiliate and local manufacturing companies. Start and expansion of water purification equipment sales activities. Promotion of the equipment not only in small towns but also in rural areas, to contribute to the achievement of the national goals of Lao PDR.

【Phase 2: Wider dissemination through contracting to long-term comprehensive projects (2021 to 2023)】

In addition to the manufacture and sale of equipment, the affiliate will establish a system with engineering and maintenance functions. The affiliate will contract into long-term projects from NPSEs (Provincial public water suppliers) integrating sales and maintenance of water purification equipment. At this time, the technology for the operation and maintenance of the water purification system will be transferred to NPSE staff.

【Phase 3: Business expansion including pipeline provision (From 2024)】

The affiliate will turn functions other than water purification system necessary for waterworks, such as maintenance and management of the pipe network, meter reading and tariff collection, water leakage control, etc., into a value chain through tie-ups with other companies, M&A, etc., and will also enter into concession-type water supply projects. The affiliate will consider participation in third-country ODA projects and private-sector water supply projects. In addition, it will also expand into neighboring countries such as Cambodia and Vietnam.

Looking to the future, TOHKEMY Corporation also aim to re-enter the market for small water supply projects in Japan (There are about 7,000 projects).

(3) Outputs and Outcomes of the Survey

- The equipment supplies 1,000m³ of drinkable water per day, enough to supply 6600 people, using raw water sourced from the Nam Ngiep River.
- The installation of the equipment has increased the piped water supply coverage of Paksan District from 69% to 89% , reaching the national goal of 80%.
- The equipment was installed as a Verification Survey of JICA under a proposal by TEAM TOHKEMY (consisting of TOHKEMY Corporation (representative), PACIFIC CONSULTANTS CO., LTD. (consultant) and LAPON Company Limited (local partner) and purifies high-turbidity river water in Lao PDR to meet the Lao PDR water quality standards (5 NTU or less).
- At the same time, in this survey three staff members of NPSE-Bolikhamxay received instruction in the technology for operation and maintenance of this water purification system .
- The results of monitoring over a period of 12 months from October 2016 to September 2017 showed that the annual average turbidity of the raw water was 167 NTU, and daily maximum turbidity was in excess of 4,000 NTU.
- Even with turbidity of 4,000 NTU, the quality of the purified water satisfied the Lao PDR water quality standards (5 NTU or less) , and it was possible to verify that the water purification system was well suited to local conditions.
- The running cost in terms of the cost of electricity and chemicals per unit of water was an average of 689 Kip / m³ over the year, which was about one quarter of the calculated estimate of 2,833 Kip m³ for the previous water purification method (flocculation + sand filtration). This was less than one-third of the initial estimated cost, confirming the cost advantage of this water purification system.

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

After the implementation of this survey, NPSE-Bolikhamxay will be responsible for the operation and maintenance of the equipment according to the technology transfer and the manual created during this survey period as one of its own waterworks.

The water purification plant will be operated 24 hours a day under a water purification plant manager and several members of staff. The cost of operating and maintaining the equipment will be covered by the water tariff.

4. FUTURE PROSPECTS

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

- The more widespread installation of the equipment in Lao PDR is, the greater the contribution to the improvement of the piped water supply coverage.
- The expansion to other provinces of technology transfer for the operation and maintenance of this water purification system will lead to skill development of the staff of other provincial water authorities in Lao PDR, and will improve the level for ensuring a stable supply of safe water.
- Furthermore, if it becomes possible for a local manufacturing company to manufacture part of the equipment, this will contribute to local industrial development in Lao PDR.

(2) Lessons Learned and Recommendation through the Survey

(Lessons Learned)

- As safety awareness is low, it is important to take into consideration the loan of protective equipment when work is carried out by local workers.
- Even though drawings were submitted, the work was not always carried out according to the specified dimensions/correlations. Therefore, it is necessary to check and verify important parts after construction is completed.
- Since construction rarely progresses according to the work schedule, it is necessary for there to be plenty of leeway in the schedule and also for the state of progress to be checked at each stage.
- Since the foundation on which the equipment is to be installed is very uneven, it is necessary to take measures such as the preparation of a jig that provides ease of level adjustment (In this survey, leveling was facilitated through the installation of leveling bolts on each piece of equipment.)
- Though chemicals such as germicides and flocculating agents are available in liquid form in Japan, in Lao PDR chemicals in solid form need to be dissolved before use. Since undissolved matter can clog the injection pumps, leading to deterioration of the quality of the treated water, it is necessary to work out a means of separating out any undissolved matter.
- A level sensor was damaged by lightning during the Survey. Though the control panel was protected by a lightning arrester, damage to the main body could not be avoided. In areas where lightning strikes are frequent, sufficient measures need to be taken in the use of precision equipment, and as far as possible equipment that is available locally should be used. (Even items that are readily available in Japan are often difficult to obtain in Lao PDR.)
- When water intake for the equipment is from river water, the fluctuation in

turbidity can exceed 1,000NTU a day, so that manual adjustment of the amount of chemicals to be injected is considered difficult. In order to achieve stable water quality from raw river water, it is considered essential that the turbidity of the raw water be measured continuously and chemical injection controlled automatically. If such measures cannot be taken, measures such as restricting the raw water intake are necessary.

- Since there is little awareness of the need for cleanliness and tidiness within the facility, it is necessary to make workers aware of the need for daily tidying and cleaning in and around the facility, as a part of operation management.
- Since it often happened that malfunctions and problems were dealt with only after they occurred, operators need to learn to try to prevent such malfunctions and problems before they occur, through daily checks and inspections.
- Though the equipment is installed indoors, during the rainy season the measuring instruments and control panel were invaded by large numbers of ants. Since there seems little that can be done to prevent this in terms of hardware, daily checks by staff are necessary.
- Due to the lack of basic knowledge and experience of water treatment and equipment, difficulties were felt in explaining operational procedures. Some means of encouraging mastery of the basics is required.
- The Survey Team is especially grateful for all the support provided in import and customs duty procedures, including the issue by the counterpart organization of a letter of support, which enabled customs clearance to proceed smoothly.

(Recommendations)

- The survey supports the overseas expansion of SME (small medium-size enterprises). The survey became a local showcase undertaking; it was very beneficial in gaining recognition of the equipment among people involved in the water supply in Lao PDR and helped to promote its branding to some extent. Though it provides a foothold for the expansion and spread of business locally, there are concerns regarding local funding. In a water supply project, expenses are recovered from the water tariff over a long period spanning several decades. However funding for the initial investment is far from easy, leading to a vicious cycle: the construction of facilities does not make headway → income from water tariffs does not increase → maintenance costs increase due to the aging of the facilities → waterworks fall into financial difficulties..

For these reasons, it is strongly recommended that consideration be given to the establishment of small-lot loan schemes suited to initial investment to support the introduction and development of small-sized water purification facilities, the establishment of a financial support framework specializing in water facility development, and support for subsidy programs for water supply projects in Lao PDR.

- Difference in recognition of the usefulness of the equipment in comparison with Japan (Turbidity above 100NTU is usual in Lao PDR, unusual in Japan)

As was shown in the results of the water quality monitoring, the turbidity of the river water (surface water used as the water source) in the area of the Mekong River rises to an average of around 200NTU during the rainy season, with daily peaks of around 1,000NTU; this can rise to over 4,000NTU in extreme circumstances, such as an upstream dam break. In Japan, 200NTU is considered a level that might be recorded for short periods of time as a result of torrential rain, and is not normal. Thus, what is considered water treatment under extreme circumstances in Japan is normal during the rainy season in Lao PDR.

Therefore, it is extremely difficult to apply Japanese experience and performance to the evaluation of performance and economic efficiency in Lao PDR. This point should be recognized and understood when the usefulness of this equipment is compared with experience and performance achieved with other equipment.

- Awareness building of the survey scheme (burden sharing)

The survey was carried out and the flow of treated water accomplished thanks to the civil engineering and construction works implemented by the Lao PDR side and the installation of the equipment on the Japanese side. Having the Lao side bear some of the burden significantly raised their commitment and interest in the survey.

By paying their own expenses, they exhibited excellent leadership, had a greater sense of mission and responsibility, and were able to execute the survey successfully. We expect that this survey will be recognized as a successful example for both Lao PDR and Japan and will help in the adaptation of other cases as well as improving water supply coverage.

Verification Survey with the Private Sector for Disseminating Japanese technologies of Water Purification System for Highly Turbid Water for Use in Small Town Water Supply
TOHKEMY CORPORATION, Osaka, Japan



Concerned Development Issues in LAO

- There are some problems such as Regional disparities in water service and Stable supply of safe water.
- It is required to purify surface water with cost savings and supply stably, even though the surface water is remarkably high turbid under rainy weather, under the conditions of good-quality groundwater sources are going to be in short.

Implemented Activities in the Survey

- By introducing a high-turbid water purifying system in Paksan area, Bolikhamxay, the JICA Survey Team will verify local adaptability of it's system.
- Transfer the technology of the operation and maintenance of the "The water purifying system" to staff of NPSE-Bolikhamxay.
- Formulate a dissemination plan after the "Survey".

Proposed Products/Technologies



Water Purification System for Highiy Turbid Water =Fiber filters (Actifiber) and Sand filtration System.
-Technology of Fiber filters (patent)
-Utility cost can be reduced by around a one-third in comparison with coagulation-sedimentation system .
-Construction period and space can be shortened and smaller.

Survey Overview

Name of Counterpart:
 Department of Public Works and Transport of Bolikhamxay Province/
 NPSE-Bolikhamxay
 Survey duration:From June, 2015 to May, 2018 (3 years)
 Survey Area:Paksan District, Bolikhamxay Province in LAO

Impact on the Concerned Development Issues in LAO

- Established stable purification system for highly turbid water.
- The population served by water supply will increase.
- Running cost decreases in comparison with a conventional method.

Outputs and Outcomes of the Survey

- The installed equipment supplies 1,000m³ of drinkable water per day.
- Even with turbidity of 4,000 NTU, the quality of the purified water satisfied the Lao PDR water quality standards (5 NTU or less) ,and it was possible to verify that the water purification system was well suited to local conditions.
- After the Survey, challenge to the public water supply project, private urban development business and industrial water business in Lao.



ລາຍງານໂຄງການທົດລອງຕົວຈິງຂອງລະບົບ
ກັນຕອງນໍ້າທີ່ສາມາດບໍາບັດນໍ້າທີ່ມີຄວາມຊຸ່ນສູງ
ສໍາລັບຕົວເມືອງນ້ອຍຢູ່ ສປປລາວ

TOHKMEY CORPORATION



1 ໂຄງການສາທິດແລະສົ່ງເສີມ (JICA)



* ຈຸດປະສົງ

- * ສົ່ງເສີມໃຫ້ບໍລິສັດນ້ອຍແລະກາງ ນໍາສະເໜີ ຜະລິດຕະພັນ ແລະ ເຕັກໂນໂລຊີ, ຍົກລະດັບເຕັກນິກ ໃຫ້ເໝາະສົມກັບບັນດາປະເທດທີ່ກໍາລັງພັດທະນາ ເພື່ອໃຫ້ມີການນໍາໃຊ້ຢ່າງກ້ວາງຂວາງ.
- * ອົງໃສ່ໂຄງການດັ່ງກ່າວ ບັນດາໂຄງການຂອງລັດຖະບານ ແລະໂຄງການຊ່ວຍເຫຼືອຕ່າງໆ ສາມາດນໍາໃຊ້ ຜະລິດຕະພັນ ແລະ ເຕັກໂນໂລຊີ ຫລາຍຂຶ້ນ, ໂດຍການແຜ່ກະຈ່າຍ ຜະລິດຕະພັນ ແລະ ເຕັກໂນໂລຊີດັ່ງກ່າວ ຄຽງຄູ່ກັບການອອກສູ່ຕະຫຼາດສາກົນຂອງ ບໍລິສັດນ້ອຍ ແລະ ກາງ ສາມາດຊ່ວຍພັດທະນາເສດຖະກິດໃນເຂດພາກພື້ນນັ້ນໆ.



2 ໂຄງການສາທິດແລະສົ່ງເສີມລະບົບກັນຕອງນໍ້າທີ່ມີຄວາມ ຊຸ່ນສູງ ສໍາລັບທຸລະກິດນໍ້າປະປາຕົວເມືອງນ້ອຍ

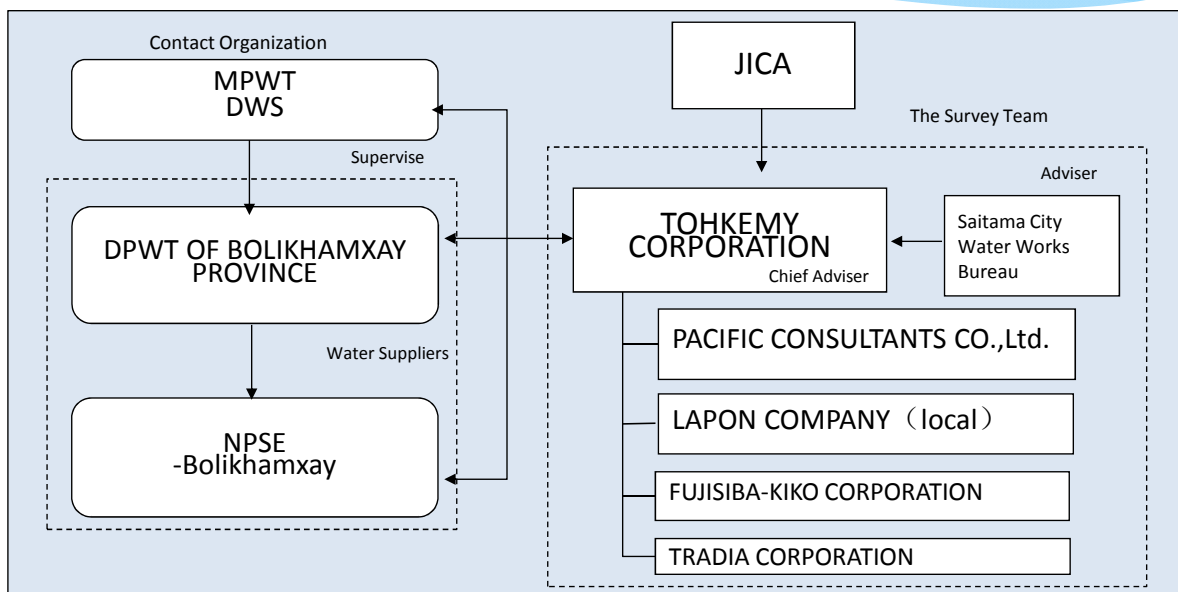
1) ຈຸດປະສົງຂອງໂຄງການ

- * ນໍາໃຊ້ລະບົບກັນຕອງນໍ້າທີ່ມີຄວາມຊຸ່ນສູງເພື່ອປັບປຸງເຂົ້າເຖິງນໍ້າທີ່ປອດໄພຂອງປະຊາຊົນໃນ ເຂດສາມາດໃຫ້ດີຂຶ້ນ
- * ການຍັງຢືນລະບົບທີ່ເໝາະສົມກັບສະພາບຕົວຈິງ
- * ກໍານົດແຜນຂະຫຍາຍ ເພື່ອປະກອບສ່ວນໃນວຽກງານການສະໜອງນໍ້າປະປາ

	ປະຈຸບັນ	ເປົ້າໝາຍປະສິດທິຜົນ	ເພີ່ມເຕີມ
ປະຊາກອນບໍລິການ	13,905ຄົນ (69%)	17,778ຄົນ (88%)	20,101ຄົນ ກ່າຍ80%ຂອງເປົ້າໝາຍລັດຖະບານ (ປີ2020)
ແຫຼງນໍ້າ	ນໍ້າບາດານ	ແມ່ໜ້າດິນ	ບັນຫາເລືອງທຸກດທິນປູນ ປະລິມານນໍ້າບໍ່ພຽງພໍ
ຄຸນນະພາບນໍ້າ		ຕໍ່າກ່ວາ 3NTU	ແຫລງນໍ້າ ~3000NTU
ຕົ້ນທຶນການຜະລິດ		1/3ຂອງແບບທົ່ວໄປ	
ຍົກລະດັບພະນັກງານ ນໍ້າປະປາ		ຮຽນເຕັກນິກໃໝ່	ລະບົບແທກຄວາມຊຸ່ນອັດຕະໂນມັດ, ໃຊ້ ພະນັກງານໃນການຄຸ້ມຄອງໜ້ອຍ

2 ໂຄງການສາທິດແລະສົ່ງເສີມລະບົບກັນຕອງນໍ້າທີ່ມີຄວາມ ຊຸ່ນສູງ ສໍາລັບທຸລະກິດນໍ້າປະປາຕົວເມືອງນ້ອຍ

2) ໂຄງຮ່າງການຈັດຕັ້ງການປະຕິບັດໂຄງການ



2 ໂຄງການສາທິດແລະສົ່ງເສີມລະບົບກັນຕອງນໍ້າທີ່ມີຄວາມຂຸ່ນສູງ ສໍາລັບທຸລະກິດນໍ້າປະປາຕົວເມືອງນ້ອຍ



3) ຂໍ້ມູນລວມຂອງລະບົບ

- ນໍ້າໃຊ້ເຕັກໂນໂລຊີເສັ້ນໃຍ(FIBER)ຕອງນໍ້າຂຸ່ນສູງ ກັນຕອງສິ່ງທີ່ເຮັດໃຫ້ນໍ້າຂຸ່ນ, ສາມາດກັນຕອງນໍ້າທີ່ມີຄວາມຂຸ່ນຂຶ້ນສູງໄດ້

ລະບົບກັນຕອງ	ເສັ້ນໃຍຕອງຄວາມຂຸ່ນສູງ+ ເສັ້ນໃຍຕອງຄວາມຂຸ່ນຕໍ່າ+ຕອງຊາຍ 【ລະບົບຖັງຕອງ3ຂັ້ນ】
ຄຸ້ມຄອງຄຸນນະພາບນໍ້າ	pH ຄໍລິນ ຄວາມຂຸ່ນ
ນໍ້າໃຊ້ຢາເຄມີ	ຫີນສົ້ມ, ຄໍລິນຝຸ່ນ



5

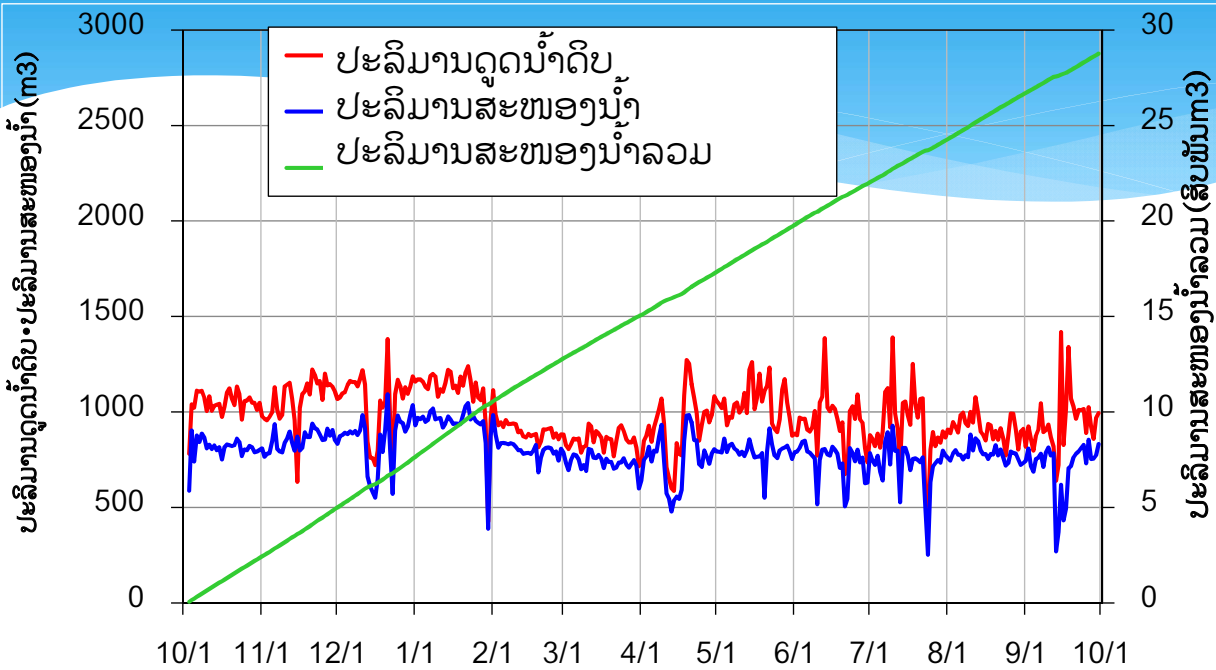
3. ປະຫວັດ(ແຕ່ການເຊັນສັນຍາ ເຖິງການກໍ່ສ້າງ)

- * ເຊັນ MOU: 15 May 2015
- * ເລີ່ມຜະລິດ: 20 Oct 2015
- * ນໍ້າເຂົ້າສະໜາມ : 30 May 2016
- * ເລີ່ມສະໜອງນໍ້າ : 3 Oct 2016

MOU - ຕິດຕັ້ງ: 1 ປີ
ໃຊ້ເວລາຕິດຕັ້ງ : 1 ເດືອນ



4. ຜົນການທົດລອງ(ປະລິມານສະໜອງນໍ້າ)



- ສະໜອງນໍ້າ 1000 m³ ໃຫ້ປະຊາຊົນປະມານ 6,600ຄົນ ຈາກນໍ້າງຽບ
- ຊ່ວຍໃຫ້ອັດຕາການເຂົ້າເຖິງນໍ້າປະປາຢູ່ເຂດເທດສະບານເມືອງປາກຊັນ ຈາກ 69% ເປັນ 89%

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5. ຜົນການທົດລອງ(ຄຸນນະພາບການສະໜອງນໍ້າ)

1) ຄວາມຊຸ່ນຂອງນໍ້າດິບ ແລະ ນໍ້າທີ່ບໍາບັດແລ້ວ

非公開

5. ຜົນການທົດລອງ(ຄຸນະພາບການສະໜອງນໍ້າ)

2) ໄລຍະຄວາມຊຸ່ນສູງຂອງແຫຼງນໍ້າ ແລະ ນໍ້າທີ່ບໍາບັດແລ້ວ (ເດືອນ ກັນຍາ 2017)

非公開

5. ຜົນການທົດລອງ(ຄຸນະພາບການສະໜອງນໍ້າ)

3) ຕໍ່ກັບຄວາມຊຸ່ນທີ່ມີການປ່ຽນແປງໄວ

非公開

5. ຜົນການທົດລອງ(ຄຸນະພາບການສະໜອງນໍ້າ)

4) ມາດຕະຖານນໍ້າປະປາ 23 ຫົວໜ່ວຍ

- ໄດ້ເອົານໍ້າທີ່ບໍາບັດແລ້ວໄປວັດແທກຄຸນພາບນໍ້າຕາມມາດຕະຖານປະເທດລາວ 23 ຫົວໜ່ວຍ ຢູ່ປະເທດຍີ່ປຸ່ນ
- ໄດ້ຍັງຢືນຄຸນະພາບຢູ່ໃນຂອບເຂດມາດຕະຖານ (06 ຕຸລາ 2016)
- ເຫັນໄດ້ວ່າລະບົບດັ່ງກ່າວແມ່ນແທດເໝາະກັບພື້ນທີ່ນີ້ດີ.

水質検査結果書
(Result of Water Quality Testing)

第 61420110号
2016年10月19日

株式会社 日本水質検査センター
株式会社 トーヨー水質検査センター
〒491-8502
大塚市平野町東六丁目14番地
TEL: 06-4797-7896
検査報告書 無効 添付

検査項目 (Sampling item)	検査結果 (Value)	検査単位 (Unit)	検査基準 (Standard)	検査結果 (Value)	検査単位 (Unit)	検査基準 (Standard)
総硬度 (Total hardness)	0	0 MPN/100ml	検査基準なし			
カルシウム (Calcium)	0.11	0.2mg/L	0.2mg/L LLT			
マグネシウム (Magnesium)	< 0.001	< 0.1mg/L	0.1mg/L LLT			
硫酸イオン (Sulfate ion)	1.2	200mg/L	200mg/L LLT			
硝酸イオン (Nitrate ion)	0.1	0.1mg/L				
亜硝酸イオン (Nitrite ion)	< 0.001	< 0.1mg/L	0.1mg/L LLT			
アンモニア (Ammonia)	< 0.001	< 0.5mg/L	0.5mg/L LLT			
亜硝酸イオン (Nitrite ion)	< 0.001	< 0.1mg/L	0.1mg/L LLT			
硝酸イオン (Nitrate ion)	< 0.001	< 0.1mg/L	0.1mg/L LLT			
マンガン (Manganese)	< 0.00005	< 0.005mg/L	0.005mg/L LLT			
鉄 (Iron)	0.5	0.5mg/L	0.5mg/L LLT			
亜鉛 (Zinc)	< 0.1	< 0.1mg/L				
銅 (Copper)	2.4	200mg/L	200mg/L LLT			
鉛 (Lead)	0.6	0.2mg/L				
亜鉛 (Zinc)	0.10	0.1mg/L	0.1mg/L LLT			
塩素 (Chlorine)	< 0.5	< 0.5mg/L	0.5mg/L LLT			
pH	7.2	0.02-8.4 LLT				
濁度 (Turbidity)	0.49	< 1000 J/m				
臭気 (Odor)	< 0.25(CP)	< 0.25	0.25 LLT			
カルシウム (Calcium)	40	< 200mg/L	200mg/L LLT			

検査結果合格
Judgment of acceptance: Pass

6. ຜົນການທົດລອງ(ຕົ້ນທຶນ)

5) ຕົ້ນທຶນໃນການຜະລິດນໍ້າ (ສານເຄມີແລະໄຟຟ້າ ຕໍ່ m³)

非公開

6. ຜົນການທົດລອງ(ຕົ້ນທຶນ)

6) ຕາມການຄິດໄລ່ ເມື່ອປຽບທຽບກັບລະບົບທົ່ວໄປ (ຕໍ່ m³)

非公開

7. ຄວາມເປັນໄປໄດ້ໃນຕໍ່ຫນ້າ

1) ການດໍາເນີນງານແລະການບໍາລຸງຮັກສາ

ການດໍາເນີນງານ ແລະ ບໍາລຸງຮັກສາໂດຍພະນັກງານນໍ້າປະປາ, ຍົກລະດັບຄວາມສາມາດໃຫ້ພະນັກງານ ສາມາດສະໜອງນໍ້າປະປາທີ່ປອດໄພ ແລະ ມີຄວາມສະຖຽນລະພາບ.



7. ຄວາມເປັນໄປໄດ້ໃນຕໍ່ຫນ້າ

2) ການຜະລິດໃນທ້ອງຖິ່ນ

ການຜະລິດອຸປະກອນໃນທ້ອງຖິ່ນຈະປະກອບສ່ວນໃຫ້ແກ່ການພັດທະນາອຸດສະຫະກຳພາຍໃນໃນສປປລາວ.



ເຕັກໂນໂລຊີຍີ່ປຸ່ນ ຜະລິດຢູ່ລາວ



8. ບົດຮຽນທີ່ໄດ້ຮຽນຮູ້



- ① ຄວາມຮັບຮູ້ຕໍ່ຄວາມປອດໄພຂອງພະນັກງານ
- ② ລະດັບຄວາມຮູ້ຂອງພະນັກງານທີ່ແຕກໂຕນ
- ③ ຄຸນະພາບທາງເຄມີ ແລະ ການຈັດການ
- ④ ອຸປະກອນວັດແທກ ເພຍ້ອນຟ້າຝ
- ⑤ ພາຍໃນມື້ດຽວ ມີກໍລະນີການປ່ຽນແປງຂອງຄວາມຊຸ່ນຂອງແຫຼງນ້ຳເກີນ 1000NTU





9. Line up



Lapon Co.,Ltd.

- * ເປົ້າໝາຍ : ຕົວເມືອງນ້ອຍ ແລະ ໝູ່ບ້ານ
- * ແຫຼ່ງນໍ້າ : ແມ່ນໍ້າ / ບຶງ / ນໍ້າບາດານ
- * ຜະລິດຕະພັນ

ປະລິມານ	100 m ³ /ມື້	300 m ³ /ມື້	500 m ³ /ມື້	800 m ³ /ມື້	1000 m ³ /ມື້
ຈຳນວນຄົນ	660	2,000	3,300	5,300	6,600
ຈຳນວນຄອບຄົວ	100	300	500	800	1,000
ພື້ນທີ່ສຳລັບເຄື່ອງຈັກ	5m x 12m	6m x 14m	7m x 17m	9m x 19m	9m x 20m
ຂະໜາດອ່າງຕອງ	3m x 12m	5m x 16m	7m x 20m	9m x 23 m	9m x 26m



ຂໍຂອບໃຈ

