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NAME: Mr. Htut Khaung Win

THIS THESIS HAS BEEN ACCEPTED BY

(Assistant Professor Cheema Soralum, Ph.D.) **THESIS ADVISOR**

(Associate Professor Sanya Sirivithayapakorn, Ph.D.) **THESIS CO-ADVISOR**

(Associate Professor Chart Chiemchaisri, D.Eng.) **DEPARTMENT HEAD**

APPROVED BY THE GRADUATE SCHOOL ON _____

(Associate Professor Gunjana Theeragool, D.Agr.) **DEAN**

THESIS

ENVIRONMENTAL MANAGEMENT SYSTEM FOR CONCRETE BATCHING PLANTS IN YANGON CITY, MYANMAR

HTUT KHAUNG WIN

A Thesis Submitted in Partial Fulfillment of
the Requirements for the Degree of
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Htut Khaung Win 2013: Environmental Management System for Concrete Batching Plants in Yangon City, Myanmar. Master of Engineering (Environmental Engineering), Major Field: Environmental Engineering, Department of Environmental Engineering. Thesis Advisor: Assistant Professor Cheema Soralum, Ph.D. 130 pages.

The purpose of this study was to create initial environmental review through environmental audits and to encourage evaluating Environmental Management System EMS (ISO 14001) opportunities based upon facility's individual operations for concrete batching plants in Yangon City, Myanmar. Because emissions from poorly-controlled concrete batching plants not only pollute the environment, and also cause serious impacts of human health. So evaluating and indentifying of significant aspects was grown to be primary objective of this research. In statistically analysis, a questionnaire consisted of 65 questions was designed to gather information on the basic general conditions about concrete plants covering raw materials consumption, precautionary measures to lower emission levels, water and leftover concrete management and control measures for noise and air pollution including inspections and audits. Then significant aspects from their activities were observed and articulated by the priority of important. In research, results were statistically analyzed by Excel software and illustrated in graphs and figures. It was found that EMS operated together with ISO 14001 could efficiently enhanced for sustainable concrete batching plants in Yangon City, Myanmar.

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Student's signature Thesis Advisor's signature

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Htut Khaung Win

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LIST OF ABBREVIATIONS

3R	=	Reuse, reduce and recycle
ACI	=	American Concrete Institute
A.D	=	Anno Domini
AOX	=	Absorbable Organic halogens
ASTM	=	American Society for Testing Material
B.E	=	Buddhist Era
BOD	=	Biochemical Oxygen Demand
BPEM	=	Best Practice Environmental Management
CA	=	Coarse Aggregate
CBB	=	Cement Bulk Boat
CBP	=	Concrete Batching Plants
CBT	=	Cement Bulk Truck
CCA	=	Crushed Concrete Aggregates
CO_2	=	Carbon dioxide
COD	=	Chemical Oxygen Demand
dB(A)	=	decibels (measured on the A scale)
EMS	=	Environmental Management System
FA	=	Fine Aggregate
EPA	=	Environmental Protection Authority

LIST OF ABBREVIATIONS (Continued)

GGBFS	=	Ground Granulated Blast Furnace Slag
HSAs	=	Hydration Stabilization Admixtures
ISO	=	the International Organization for Standardization
ISO 14001:2004	=	Environmental management systems-requirements with guidance for use
LEED	=	Leadership in Energy and Environmental Design
NRMCA	=	National Ready Mixed Concrete Association
PCA	=	Portland Cement Association
PM	=	Particulate Matter
PPP	=	Polluters Pay Policy
TSS	=	Total Suspended Solid
UK	=	United Kingdom
WMP	=	Waste Minimization Policy
YCDC	=	Yangon City Development Committee

ENVIRONMENTAL MANAGEMENT SYSTEM FOR CONCRETE BATCHING PLANTS IN YANGON CITY, MYANMAR

INTRODUCTION

In this decade, construction industry in Yangon City, Myanmar has been pushed to produce mass production in concrete batching plants for upgrade urbanization. According to the result of the last general census, 12% of the total population and 10% of the total number of buildings in Myanmar are in Yangon City. Concrete is made of water, cement, air, aggregate (fine and coarse) and admixture. During the production process of ready mixed concrete, the pollution of air, water and land, along with the use of energy and natural resources are considered negative properties. Known negative impacts of these are the unbalancing of environmental values, thus the adverse effects on human health (Cosgun and Esin, 2006).

The objectives of this research can be described as to create initial environmental review through environmental audit for concrete batching plants, to study effective Environmental Management System EMS for concrete batching systems in Yangon City, Myanmar and then objectives targets and programs to reduce their environmental impacts were proposed.

Ready-mixed concrete is a type of concrete that is manufactured by the industry as a batch plant or factory based on customer's specifications and delivered to a project site by truck or mounted transit mixers. The first ready-mixed CBP or factory was built in the 1930s, but the industry did not expand significantly until the 1960s, and it has continued to grow since then (Kelly, 2011). Year by year, the rate of casting ready-mixed concrete is increasing steadily around the world, including in Myanmar, due to several assured benefits. These include: (1) a centralized CBP is capable of serving a wide area of a city; (2) CBP produces better quality concrete compared with in-situ mixing; and (3) using ready-mixed concrete helps to reduce need for greater storage space for basic materials at project sites.

Emissions from poorly-controlled CBP not only pollute the environment, and also cause serious impacts of human health. Applying management systems based on BPEM in CBP is a proposed solution to help CBP co-exist harmoniously with surrounding communities. So EMS has become a very important area of running any medium to large scale business. Not only does good environmental management aid in achieving compliance with legislative demands (e.g., avoidance of pollution offences, due diligence) but can also be used to actually improve the companies' bottom line, via such approaches as reduced discharges of wastes, more efficient energy use, less noise, etc. Environmental management and evolving standards such as, ISO14001, for Environmental Management Systems make this area a normal extension of the Environmental Planning and Assessment process (Dr Christian Khalil, 2012).

OBJECTIVES

The main purposes of the present research are as follows,

1. To create initial environmental review through environmental audit for concrete batching plants in Yangon City, Myanmar.

2. To analyze and evaluate and identify significant aspects of Yangon concrete batching plants.

3. To propose effective planning for reducing environmental burdens of Yangon concrete batching plants.

Scope of Study

The scope of study will include,

1. The study of research focused on the concrete batching plants society within Yangon City, Myanmar.

2. In the scope, 52 plants was investigated, 52% (27 plants) that situated in industrial zones and other 48% (25 plants) that situated in river bank areas.

3. The system for environmental management was considered and it was compared with ISO 14001 or concrete batching plants of Yangon City, Myanmar.

LITERATURE REVIEW

1. ISO 14001

ISO14001 Environmental Management System (EMS) Standard consists of the EMS specification and 17 clauses, or general requirements, in five categories. Each clause was written to apply to a wide diversity of organizations. The requirements describe general outcomes of the system, and the following is a summary of the 17 ISO 14001 clauses (Kuhre, 1995).

1.1 General Requirements

1.2 Environmental Policy

1.3 Planning

- 1.3.1 Environmental aspects
- 1.3.2 Legal and other requirements
- 1.3.3 Objects and targets
- 1.3.4 Environmental management program(s)

1.4 Implementation and operation

- 1.4.1 Structure and responsibility
- 1.4.2 Training, awareness and competence
- 1.4.3 Communication
- 1.4.4 Environmental Management System Documentation
- 1.4.5 Document control
- 1.4.6 Operational control
- 1.4.7 Emergency preparedness and response

1.5 Checking and corrective action

- 1.5.1 Monitoring and measurement

1.5.2 Non-conformance and corrective and preventive action

1.5.3 Records

1.5.4 Environmental Management System audit

1.6 Management review

Together, these clauses compose the ISO 14001 EMS Standard. The world of principles, strategies, actions and tools is complex, with different ideas and frameworks often competing for intellectual dominance. The levels of the planning approach are critical to the proposed strategic planning enhancement for ISO 14001; they are covered in more detail in the following steps:

1. Construction level- principles for the constitution of the system (e.g., ecological and social principles).

2. Objective level- principles for a favorable outcome of planning within the system (e.g., principles for sustainability).

3. Strategic level- principles for the process to reach this outcome (e.g., principles for sustainable development).

4. Action level- action, i.e., concrete measures that comply with the principles for the process to reach a favorable outcome in the system (e.g., recycling and switching to renewable energy).

5. Tool level- tools to monitor and audit (i) the relevance of actions with reference to actual compliance with the plan (e.g., indicators of flows and key figures to comply with principles for sustainability), and/or monitor (ii) the status of the system itself, and impacts (e.g., ecotoxicity and employment), or reduced impacts, as a consequence of strategically planned societal actions.

Figure 1 shows the EMS cycle which is an abstract description of the different components of, plan, do, check and act. If the cycle is adhered to constantly it leads to continuous improvement of the system.EMS consists in order to see the activities that have been undertaken and with what results, according to ISO 14001 include environmental impact, use of resources like raw materials, water, energy and relevant regulation, etc.

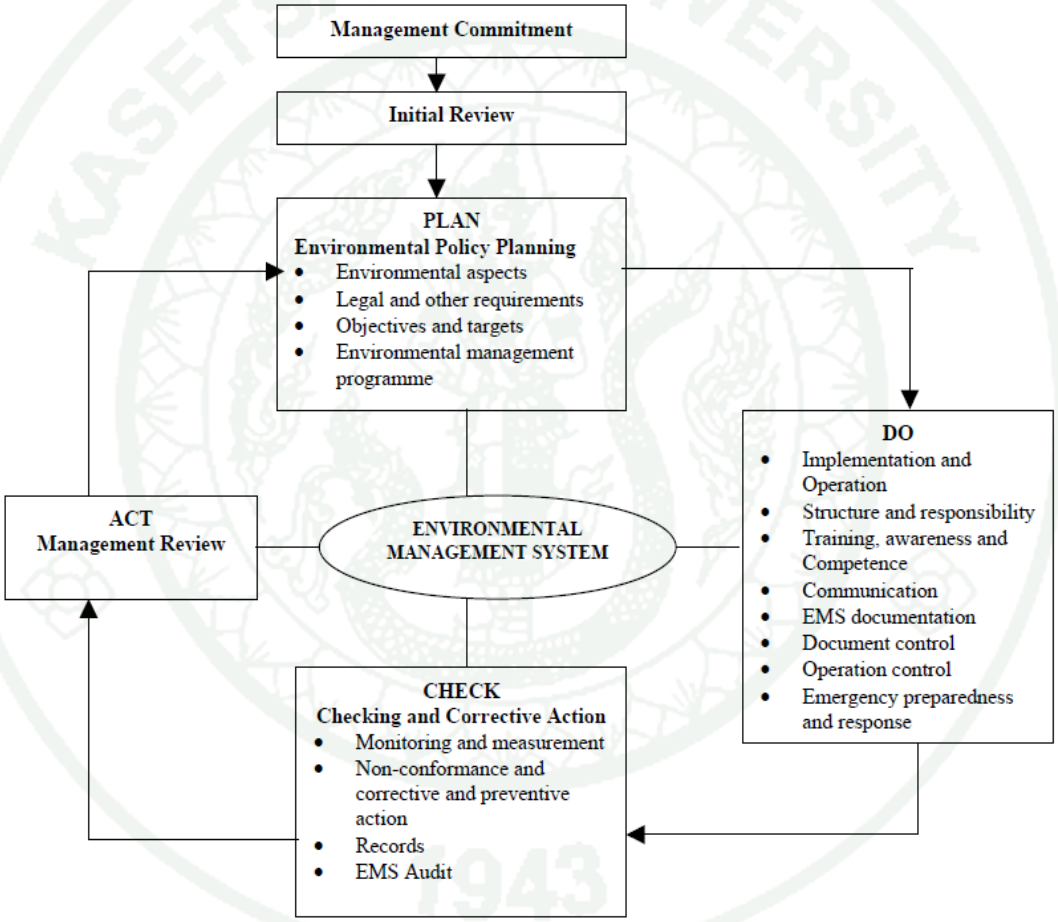


Figure 1 EMS Cycle According to ISO14001

2. Ranking scheme for Environmental Aspect Evaluation

In the some former studies and research papers, ranking system was used as a main tool for audit in representative cement batch plants (William Twitty, 2010). In ranking system, there are two divided portion for evaluation of environmental aspect,

(1) pollution aspects and (2) resource use aspects. The discussion with evaluation's criteria about these two aspects was illustrated in following table 1 and 2. The criteria from these two tables can be used for ranking scheme of significant aspects and impacts of every CBP's (Cakir, 2007).

Table 1 Environmental Aspect Evaluation Criteria (Pollution Aspect)

Type	Evaluation Criteria	Score
1. Difficulty in Pollution control	- pollution can all be controlled at its source	0
	- pollution can be mainly controlled at its source	1
	- half of pollution can be controlled at its source	2
	- pollution can be sometimes controlled at its source	3
	- pollution cannot be controlled	4
2. Frequency of incident	- never happen within the past 3 years	0
	- happen less than or once a year	1
	- twice a year	2
	- 15-20 times a year	3
	- 1-7 times a week	4
	- happen all the time	5
3. Consequence of impact	Air Pollution	
	- no impact	0
	- cause smell	1
	- destroy stratospheric ozone, cause acid deposition	2
	- cause damage to plants and animal within the surrounding area	3
	- severely endanger human beings and can cause global impact such as global warming	4

Table 1 (Continued)

Type	Evaluation Criteria	Score
3. Consequence of impact	Land Use:	
	- no impact	0
	- cause impact to habitual without damage	1
	- no long term impact (impact can be remediated)	2
	- cause long term impact	3
	- difficult for remediation	4
	Water Resource:	
	- no impact	0
	- cause physical change such as color turbidity but without long term impact	1
	- produce wastewater with parameters higher than effluent standard (pH, BOD, SS, TDS, S, TKN, Fat Oil and grease)	2
	- cause long term severe impact	3
	- destroy living organism in water and endanger	4
	Nuisance:	
	-no claim	0
	-may have claim from employees	1
	-may have claim from a nearby company	2
	-may have claim from communities	3
	-may have a claim from public media a such as newspaper, TV	4

Table 1 (Continued)

Type	Evaluation Criteria	Score
4 .Law and Legal requirement	- no legal control	0
	- have legal control and comply with the requirement	1
	- have legal control and rarely violate the requirement	2
	- have legal control and most of the time, comply with requirement	3
	- have legal control and violate the requirement all the time	4
5 .Impact to health, sanitation, and safely	- no danger or impact	0
	- may have health impact with short term recovery	1
	- may have health impact with long term recovery	2
	- severe health problem without remediation	3
	- fatal impact	4
6 .Public Attention	- none	0
	- low attention, occasionally	1
	- low attention, continually	2
	- high attention, occasionally	3
	- high attention, continually	4

Table 2 Environmental Aspect Evaluation Criteria (Resource Use)

Type	Evaluation Criteria	Score
1.Law and legal requirement	-no legal control	0
	-have legal control and comply with requirement	1
	-have legal control and comply violate the requirement	2
	-have legal control and most of the time, comply with requirement	3
	-have legal control and violate the requirement all the time	4
2. Control and Monitory Resource Use	- have a control and monitoring system with good equipment, procedure and effectively implemented	0
	- have a control and monitoring system with good equipment, procedure but occasionally implemented	1
	- have a control and monitoring system with incomplete or inadequate equipment, procedure and occasionally implemented	2
	- have a control and monitoring system with incomplete or inadequate equipment, procedure without implementation	3
	- no control and monitoring system, without implementation	4
3. Frequency of resource use per month per unit product	- continuous and constant use of resource	0
	- occasional and constant use of resource	2
	- inconstant use of resource	4

Table 2 (Continued)

Type	Evaluation Criteria	Score
4. Threat to Environment	- no threat to environment or naturally renewable or renewable with 1 year	0
	- have a threat to environment but naturally renewable or renewable more than 1 year	2
	- have a threat to environment and nonrenewable	4
5. Reuse/ Recycling	- all can be reused/ recycled	0
	- more than 50% can be reused/ recycled	1
	- 10-50% can be reused/ recycled	2
	- less than 10% can be reused/ recycled	3
	- cannot be reused/ recycled	4
6. Scale of impact	-no impact	0
	-impact within the organization	1
	-impact within local area	2
	-national impact	3
	-global impact	4

3.EPA's Environmental Performance Checklists for Concrete Batching Plants

Based on EPA, site location of plant, water quality, air quality, noise pollutions, solid waste and environmental management were needed to investigate in every concrete batching systems. So the checklists for CBPs were as followed.

Table 3 Site location of the plant

ISSUE	REQUIREMENT
Buffer zone	At least 100 meter buffer between plant and residential zone.
Groundwater	No shallow groundwater in the plant's vicinity.
Winds	Bunkers located out of prevailing winds.
Access	Plant access minimizes potential impacts on amenity.

Table 4 Water quality

ISSUE	REQUIREMENT
Paving	All working areas are paved in hard non-porous surface.
Bunding	Bunding is able to contain runoff.
Collection pit and recycle tank	Primary and secondary pumps fitted to collection pit.
	Excess water pumped to recycle tank.
	Collection pit empty of water, sand and gravel.
	Level controls working properly.
	Recycle tank large enough to store runoff from 20 mm rainfall event.
Monitoring offsite discharges	Visual alarms on console – to indicate when water is discharged from site - are installed and operable.
	pH of offsite wastewater discharges between 6.0 and 9.0.
	Suspended solids levels of wastewater discharges less than 80 mg/L.
Fuel and chemical storage	Chemicals and fuels are stored in a dedicated and adequately protected store.
	Bund around the storage facility is adequate.
	Material Safety Data Sheet available for all chemicals.
	Underground storage tanks tested in accordance with applicable Regulations.

Table 5 Air quality

ISSUE	REQUIREMENT
Aggregates	Aggregates are damp at all times.
	Wind shields are in place and offer adequate protection from the wind.
Silos	Filler caps are clearly identified and capped.
	Filler cut-off valve is installed and operating.
	High level alarms are installed and operating.
	Adequate test circuit.
	Hatches are air-tight.
	Dipping points are air-tight.
	Filter vents and silo protection valves are ducted to a ground level collection point.
	Cement discharge valves have fail-safe actuators.
	Flexible joints downstream of valves.
Conveyors	Conveyors covered and protected from winds.
	Transfer points fully enclosed.
	Conveyors spillage control provided.
	Conveyors fitted with belt cleaners.
Filters	Filter system in correct operating condition (service and maintenance records complete).
Weigh hoppers	Separate filters on cement silo and weigh hoppers.
	Overfill protection installed and operational.
Emergency shut-down	Emergency shut-down system operates from console and silo delivery point.
Loading bay	Loading bay is enclosed.

Table 6 Noise emissions

ISSUE	REQUIREMENT
Process equipment	Noisy equipment fitted with suitable enclosures.
	No excess noise emissions apparent.
Warning devices	No excess noise emissions apparent.

Table 7 Solid waste management

ISSUE	REQUIREMENT
Waste concrete	All concrete wastes should be returned to the plant.
	Concrete waste return and disposal are monitored and documented.
Warning devices	Waste concrete is reclaimed or recycled.
	Wastes disposed in storage pit, dried, then removed for recycling or to a license landfill.

Table 8 Environmental management

ISSUE	REQUIREMENT
Waste minimization	WMP developed and implemented.
EMS	Environmental policy developed and widely disseminated to staff.
	EMS developed, implemented and continuously reviewed.
Community liaison	Complaints are recorded, investigated and the complainant is advised of the outcome.
	Mechanisms are in place for community liaison.

4. Concrete Batching Processes

The most important aim of this thesis is to improve the overall environmental performance of the cement batch plants and to prevent the pollutions from these plants to our environment. The ISO 14001:2004 standard defines the environmental performance as measureable results of an organization's management of its environmental aspects (Deligiannis and Manesis, 2008). In production process, we can illustrate as a representative diagram as follow in Figure 2.

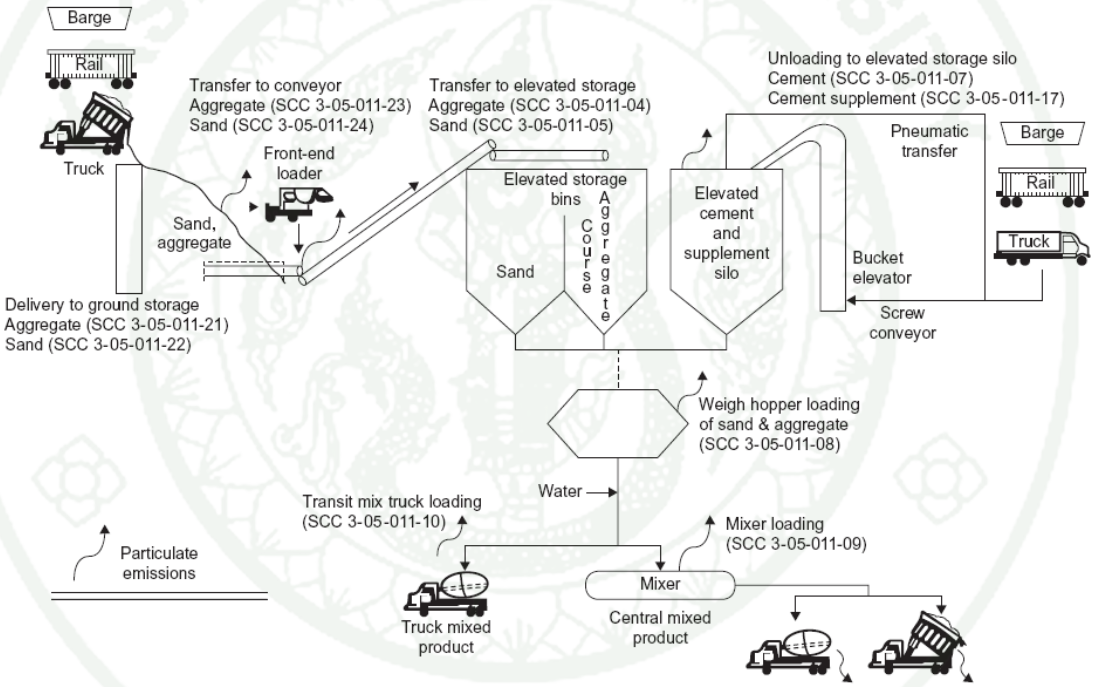


Figure 2 Typical Batching Process

Source: (Woodson, 2011)

Basically, the process of concrete production is relatively very simple, and in concrete batching industry, there are two fundamental processes; they are (1) Front end loader concrete batching and (2) Overhead bin concrete batching. These two types depend on methods of raw materials storage and transportation. In front end loader concrete batching plants, coarse and fine aggregates are transported by using

frond end loaders from ground level storage bins to weight hopper and after that added to the agitator. Other major materials cement and fly ash are weighted in a separate hoper and transferred to the agitator. In agitator, the correct estimated proportion of water is added and mixed all together. After mixing in process duration, mixture is ready for final slumping, inspection and transportation to the onsite customers (Woodson, 2012).

In overhead bin concrete batching plants, coarse and fine aggregates are stored in separate bins and transported to a compartmentalized overhead storage hopper by conveyor belts. The weight hopper is normally situated directly beneath the overhead storage hopper, where aggregates are weighted and transferred to the agitator. Cement and fly ash are stored in separate overhead silos also and they are weighted in a separate hopper and dropped into the agitator. The correct estimated proportion of water is added and along with any required admixtures and the concrete mixture is mixed, ready for final slumping, inspection and transportation to the building site.

In concrete production, required water amount to chemically combine the cement is about 16% by weight, but for more efficient mixing a greater amount of water in used. Adding more water weakens the concrete, but makes it easier to work with and good for workability. Aggregates are the major raw material of concrete and consisting of gravel and sand and they are graded according to their size and character in concrete production process. Admixtures are chemical compounds added to the concrete in small quantities to modify its properties.

5. Legislations, Policies and Regulations for Concrete Batching

In every type of concrete batching plants, it is need to control the process by legislations, policies and regulations to be sustainable industry. In Australia, the *Environment Protection Authority EPA* administered the *Environment Protection Act 1970* and it provides for the control of water, air and land pollution, industrial waste and noise. This EPA can require industry to conduct waste audits and prepare waste management plans. Australia government used the *Industrial Waste Management*

Policy (Waste Minimization) 1990, specific objectives for minimizing industrial waste generation through avoidance and reduction in preference to recycling and reclamation.

And they used the *State Environment Protection Policy (The Air Environment)*, which applies to Victoria's air environment, sets out; beneficial uses, air quality objectives, design ground level concentrations, plume calculation (dispersion modeling) procedures and control requirements for specific industry groups. The *State Environment Protection Policy (Waters of Victoria)* applies to all surface waters within Victoria. The policy defines segments of environment, beneficial uses, water quality indicators and objectives and emission limits for waste discharges to surface waters – including a requirement that the pH of discharges be in the range 6.0 to 9.0.

Concrete batching plants may generate prescribed waste to the environment (for example, waste oil and alkaline sludge are prescribed waste). Prescribed waste can only be removed from a site by an approved waste transporter. So the *Environment Protection (Prescribed Waste) Regulations 1998* classify certain industrial and domestic wastes as prescribed waste in Australia. Owners and operators from concrete batching plants should confirm the status of specific waste streams and their responsibilities with local environment authorized organization (EPA and Authority, 1998).

Waste minimization is also very effective strategy and can focus on waste avoidance and reduction through the use of better process and practice in concrete industry, pollution control and waste disposal costs can be lowered. This useful tool Waste Minimization Policy WMP includes good housekeeping practices and staff attitudes, as well as technical factors. WMP sets out waste avoidance/reduction, reuse, recycling and reclamation, waste treatment and waste disposal. Actions as simple as reducing the volume the volume of water used during washout may significantly reduce waste generation (EPA, 1993).

6. Environmental Laws and Regulations (Comparison between Thailand and Myanmar)

6.1 Environmental Laws

Thailand has had environmental laws or laws with environmental aspects for many years but Myanmar Environmental Conservation Law was just enacted by Myanmar Senate. Concern for the environment has increased in Myanmar in the last few years. Nowadays general populace also becomes aware of the impact of the ruination of the environment and failure of conservation on their daily lives and the health of their families. So it is emergency needed to publish standards and regulations of Environmental law in Myanmar. The following articles were already articulated in Thailand Acts and regulations and they can be referred for Myanmar Environmental standards and regulations for Myanmar CBPs.

6.2 Air Quality and Laws Controlling Air Pollution (Thailand)

The Office of the National Environment Board has set emission standards for oil refineries, cement, iron smelting, and steel rolling plants. In addition, the Ministry of Industry has set requirements for the mandatory use of electronic devices in locally produced automobiles to help reduce air pollution.

While there are established emission standards for motor vehicles that limit carbon monoxide (CO) emission when the vehicle is idle and restrict smoke concentration to meet air pollution control standards, the enforcement of these target levels has been inadequate and irregular. As a result, existing air pollution levels and CO emissions in Bangkok are regularly higher than the prescribed safety levels. Studies of Bangkok traffic police personnel show a remarkably high incidence of respiratory ailments.

The Land Traffic Act B.E. 2522 (A.D. 1979), as amended by the Land Traffic Act No. 8 B.E. 2551 (A.D. 2008), prohibits using automobiles and

motorcycles which discharge smoke, dust, or noise exceeding the prescribed basis. Those convicted of violating the law are subject to a fine of not more than THB 1,000.

The Land Transport Act B.E. 2522 (A.D. 1979), as amended by the Land Transport Act No. 11 B.E. 2550 (A.D. 2007), determines that vehicles used in transport must be adequately powered and correctly fitted with equipment and components as prescribed in Ministerial Regulations. Those convicted of violating the law are subject to a fine of not more than THB 50,000.

The Factories Act B.E. 2535 (A.D. 1992), including certain regulations and notifications issued under the 1969 Factories Act, is the principal law controlling air pollution by factories. In addition to providing penalties for a company operating a factory in violation of stipulated requirements, the company's directors, managers, and operators of the factory may also be individually liable for damages and criminal violations, unless they can prove they did not have knowledge of the acts related to air pollution.

6.3 Laws Controlling Water Management (Thailand)

The Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (A.D. 1992) empowers the Ministry of Science, Technology, and Environment to issue emission or effluent standards for the control of wastewater discharge and the discharge of wastes into public waters. Ministerial notifications and regulations issued under the Factories Act B.E. 2512 (A.D. 1969) control the level of effluent discharged by factories and restrict concentration levels of chemical and/or metal pollutants to defined parameters. The Navigation in Thai Waters Act B.E. 2456 (A.D. 1913) bans the discharge of pollutants and substances harmful to any water source. Permission to dump anything from stones to chemical products into canals, rivers, lakes, or ocean bodies must be obtained from the Harbor Department.

6.4 Laws Controlling Noise Pollution (Thailand)

Standards for acceptable noise levels of automobiles and motorcycles and methods for inspection are specified under the Notification of the Ministry of Natural Resources and Environment Re Noise Levels of Motor Cars dated 7 July B.E. 2546 (A.D. 2003), issued under Section 55 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (A.D. 1992).

Regulations and notifications issued under the Factories Act B.E. 2535 (A.D. 1992) are the major laws controlling noise pollution from factories. In addition, the Ministerial Regulation on Prescribing Standards for Administration and Management of Occupational Safety, Health, and Environment in Relation to Heat, Light, and Noise B.E. 2549 (A.D. 2006), issued under Sections 6 and 103 of the Labor Protection Act B.E. 2541 (A.D. 1998), also addresses the issue of noise pollution.

6.5 Laws Controlling Solid Waste Disposal (Thailand)

Solid waste management comes under the Public Health Act B.E. 2535 (A.D. 1992), which designates local administrators as being fully responsible for developing, operating, and enforcing regulations regarding solid waste disposal. The Public Health Act requires that local communities must provide receptacles as needed, provide collection and disposal of solid waste, and collect fees. Violation of this Act is subject to a fine of up to THB 5,000 per offense.

The Factories Act B.E. 2535 (A.D. 1992) provides the Ministry of Industry (MOI) with the power to establish and oversee factory operations. While the Act allows the MOI to issue regulations setting limits on discharges of air pollutants, effluents, or wastes from factories, and allows for occupational health and safety standards for the workplace, a loophole exists exempting government-owned factories from compliance.

7.Fundamental Analysis and Solutions for Wastes Control of CBPs

Normally in concrete batch plants, it is difficult to estimate accurately the quantity of waste generated. Because each plant will exhibit individual production practice as a result of local differences in plant design, market, geology, management and personnel. But most ready-mixed concrete plant waste arises from three sources, they are (1) washing out truck mixer drums at the end of each working day to prevent fresh concrete residue from setting in the drum overnight, (2) washing down the yard and plant and (3) occasionally unwanted fresh concrete is returned to the batching plant from site.

One of the previous studies published that most UK ready-mixed concrete plants have inherited a system for managing waste that dates from an era unaware of environmental pressures and the need to conserve resources (Sealey et al., 2001). This system, known as washing out, is described as follows,

1. The empty truck mixer drum is filled with water.

2. The drum is rotated in an effort to wash residual concrete from the interior of the drum

3. The entire contents of the drum (water and solids) are discharged into a large pit

4. Water discharged into pit is allowed to drain into a separate facility where it may be recovered and recycled. The solids remain in the pit

5. The pit is emptied periodically contents being transferred to a drying out

6. The contents of the drying out bay are disposed of to landfill. The bay is emptied when it is full and when the contents are dry enough to be handled

Figure 3 Washing out system for concrete waste (Sealey et al., 2001)

In the United Kingdom, many plants already change their ready-mixed concrete waste management since last decade. But these modern techniques have advantages and disadvantages as follow in table 9.

Table 9 Advantages and disadvantages of modern techniques in concrete waste management system

Method	***Advantages***	***Disadvantages***
Traditional washing out	-System already exists at most plants -Easy to operate -Low technology and low maintenance	-Produce a cementitious slurry which is increasingly expensive to dispose of -Requires extensive yard space -Take a long time to drain waste
Chemical wash out	-Requires significant capital investment -Very little space required	-Relatively high ongoing costs

Table 9 (Continued)

Method	***Advantages***	***Disadvantages***
Stoning out	-No capital costs -All materials can be reused -Inexpensive	-Requires ground storage -Not suitable after a minority of mixes
Reclaimer	-Little space required -All materials can be reused -Efficient if well managed	-High capital costs -High maintenance costs -Requires good management -Requires a consistently high production plant to work efficiently

Source: (Sealey et al., 2001).

And another former research paper focused greening technologies of the concrete industry. The concrete industry is known to leave and enormous environmental footprint on Planet Earth. First, there are the sheer volumes of material needed to produce the billions of tons of concrete worldwide each year. Then there are the CO_2 emissions caused during the production of Portland cement. Together with the energy requirements, water consumption and generation of construction and demolition waste, these factors contribute to the general appearance that concrete is not particularly environmentally friendly or compatible with the demands of sustainable development (Meyer, 2009).

One of the recent effective survey pointed out some cementitious materials can use as the recycled materials in concrete production process. They are fly ash, ground granulated blast furnace slag (GGBFS), silica fume, recycled concrete, post-consumer glass, recycled tires and recycled plastics. Reusing recycled materials, the potential tools and strategies to meet the environmental challenges can be summarized follows: (1) to replace as much Portland cement as possible by supplementary cementitious materials, especially those that are by-products of industrial processes, such as fly ash, ground granulated blast furnace slag, and silica fume, (2) to use

recycled materials in place of natural resources, (3) to improve durability and service life of structures, thereby reducing the amount of materials needed for their replacement, (4) to improve concrete's mechanical and other properties, which can also reduce the amount of materials needed, (5) to reuse wash water.

And benefits are in addition to the greatly reduced life-cycled costs for green building compared to traditional buildings. Moreover, the perception is gaining momentum that a building that is not "green" is lower quality than one that is. It is to be expected that rating systems such as the LEED (Leadership in Energy and Environmental Design) system of the United States Green Building Council will become the norm in the very near future, and material suppliers such as concrete producers will be passed to complete on the basis of environmentally friendly principles, that is, reduced energy consumption, reduced life-cycle costs, and the use of recycled materials. Some recycled materials are by-products from other industries and they became value-added materials after finished recycling process.

A concrete batching plant must be well managed if it is to achieve consistently sound environmental performance and this is best done by the development and implementation of an operational Environmental Management System (EMS). An EMS can be part of a wider quality management system. A throughout review of the plant's environmental impacts should be carried out. An EMS, which includes specific objectives and targets, to reduce impacts can then be prepared. The EMS should address responsibilities, communication processes, document control and operational procedures. A manager at the plant should have the skills, authority and accountability to deal with environmental issues. System should be established to regularly maintain operations, and to monitor and review environmental performance. The EMS should be regularly reviewed to verify performance and identify areas for improvement.

The EMS guidelines provide the every CBP with,

1. An outline of the potential impacts generated by concrete batching operations and their impacts on particular environmental attributes

2. Environmental performance objectives for each environmental attributes

3. Measures to avoid adverse environmental impacts

4. Sufficient flexibility to meet the environmental objectives by other measures, as long as they achieve equivalent outcomes.

7.1 Batch on top.

The previous research paper expressed and approved small quantities of fresh returned concrete (less than 5% of volume in drum) can be used with the next batch without affecting its properties (Cris Argeles, 2010). If the amount of left fresh concrete amount is more than 5%, Hydration stabilizing admixtures (HSAs) can also be used to stabilize the hydration of cement and these Hydration stabilizers with water are sprayed on the mixer's walls at the end of the day.

In the following day, the new concrete batch is placed into the truck, without reclaiming the previous days' returned concrete. Although stabilizing admixtures are expensive, their use can be cost-effective when returned concrete is reused, disposal costs avoided and water use for truck washout reduced; 300 liters instead of 3,000 liters (B J Sealey, 2001). This measure is usually adopted in small scale batching plants, and although it can be cost-effective, it is not considered always practicable as product specifications can limit its use (Obla K, 2007).

7.2 Stoning out.

Another efficient way of cleaning the truck's drum mixer is by "stoning out" for the returned concrete at the end of the day. It has simple calculation for wastes discharge ratio, if one of the concrete mixers is loaded with two tons of aggregate and 200 liters of water and is then brought to the point of discharge about 4 to 5 times.

The mixture can either remain in the truck overnight and then used the next day after making some adjustments as part of the first batch, or placed on the top of the aggregates stockpile for future use (Sealey et al., 2001). Stoning out is an efficient way of retrieving and reusing returned concrete as aggregates since it require no investment, maintenance and admixture costs.

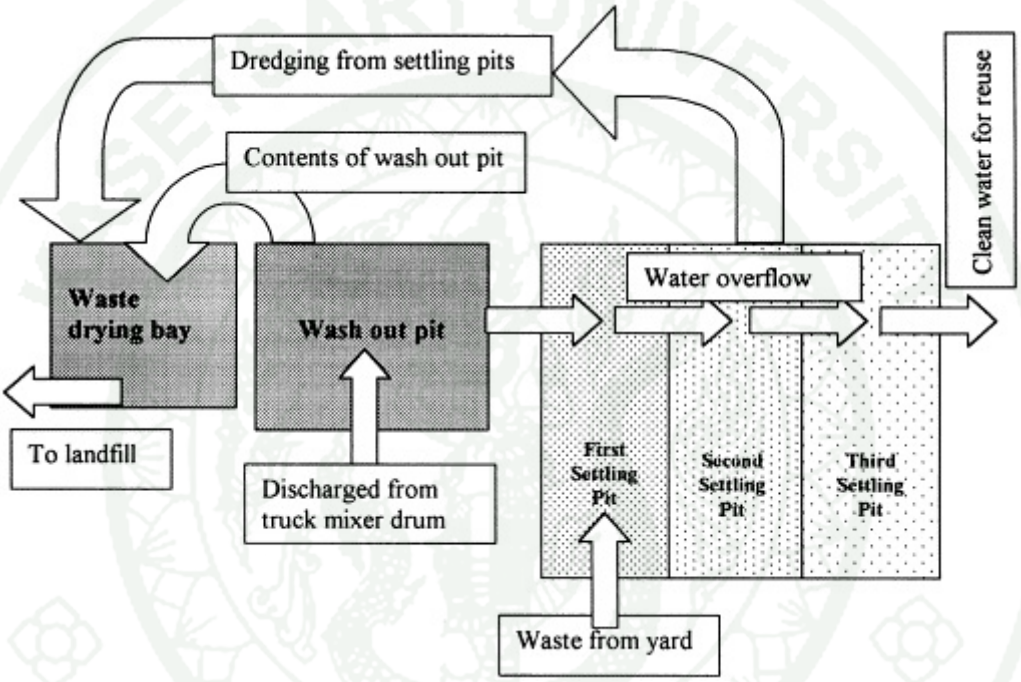


Figure 4 Stoning out system for concrete waste (Sealey et al., 2001)

7.3 Mechanical concrete reclaimer.

Concrete returned to the plant can be processed through a mechanical reclaimer, able to separate aggregates and grey water (slurry composed of cement and water). The reclaimed aggregates and grey water can then be used in the concrete mixer. Main advantages are reuse of returned concrete and elimination of wash out water.

The capital investment for obtaining a concrete reclaimer is significant and according to literature, can range from $90,000 and $350,000 (Blevins, Apr 10, 2012).

The equipment is highly complex and requires careful operation and maintenance (Sealey et al., 2001). The reduction in disposal costs varies from approximately 40% to 80%, depending on whether both coarse and fine aggregates are recycled or not. The net cost savings are highly influenced by disposal costs and the price of virgin coarse and fine aggregates.

Figure 5 Rclaimer system for concrete waste

In an average ready mixed concrete facility (60,000 yd^3 annual production), the net cost savings for a $16/ton disposal cost, can range between $0.5 and $2.5/$yd^3$ of concrete produced. The payback time is estimated to range between 2.5 and 3 years. Recycling is limited in large ready mixed batching facilities as it requires high initial investment and careful operation (Obla K, 2007) . The payback time for larger facilities (more than 100,000 yd^3 per year) is less than 2 years.

7.4 Mechanical reclaimer plus HSAs (100% waste recycling system).

Returned concrete is fed through a plume to a mechanical reclaimer. Coarse aggregates are separated and led to the coarse aggregate stockpiles. Cement and cementitious materials, along with fine sand and water are transferred to a primary tank while HSAs are added. By adding HSAs, hydration of cement is

suspended and a part of its cementitious value is available for future use. The primary tank's content is then transferred to the second tank for use as batch slurry, while during transfer it is being mixed with fresh or process water in order to meet the customer's product specifications (Colin Lobo, 2003).

This recycling system reuses 100% of generated waste in a ready mixed concrete facility. Without the use of HSAs, the use of recycled concrete in batching would not be possible. There are a number of concrete facilities in the U.S., Europe and Japan successfully using this 100% waste recycling scheme (Colin Lobo, 2003). The economic feasibility will depend on the disposal cost of returned concrete and process water, on the cost of virgin aggregates and water and the rate of waste utilization achieved.

7.5 Crushing and recycling concrete.

Fresh concrete, when returned to the plant site can be left to harden and used afterwards in a crusher for further processing. Crushed concrete aggregates (CCA) can then be used in concrete production or at the plant site, as road base or fill. According to Obla et al. (2007) this recycling option has a significant potential in the U.S. and could be used to recycle 60% of returned concrete.

Potential cost savings depend on whether returned concrete is separated into different strength classes, and into coarse and fine particles (Obla K, 2007). When it is not separated into strength classes, the CCA content of aggregates used in concrete mixing should not exceed 10% 69 (assuming CCA is derived from lower strength returned concrete), as more cement and admixtures are required to compensate for strength losses. When separated by strength classes the share of CCA can increase to 30%, improving the cost benefits. When CCA is separated according to strength classes and particle fineness, the savings achieved are maximized.

The net cost savings vary according to the CCA separation scheme adopted and range between \$0.3 and \$4.0/yd^3 of concrete produced (Obla K, 2007).

For higher disposal costs, the net cost savings increase drastically and can range between \$3 and \$12/yd^3.

7.6 Process Water

Fresh water is a valuable, scarce and usually expensive resource. It should be used with great care. Water in ready mixed concrete plants is used in concrete batching (14-18% of fresh concrete is water), aggregate heating or chilling, truck and central mixer wash out, and in dust emission suppression operations where various facility areas are sprayed with water. In precast plants, water is mainly used for batching and curing.

Water consumption shows great variations for different facility types. Ready mixed concrete plants without a central mixer tend to consume more water for truck washing when compared to central mix plants, since the drum is loaded with dry materials instead of fresh concrete. Plants in rural areas where longer travel distances exist for product delivery, are likely to have higher water consumption as they mainly use transit mixers, and large plants in urban sites are more likely to have adopted a water recycling scheme (Cris Argeles, 2010).

According to Marceau et al. (2007) (based on 27 ready mixed concrete plant responses), the average water consumption in a ready mixed concrete plant is 13 gallons/yd^3 (65 liters/m^3) without including the water used in concrete batching, and 7 gallons/yd^3 (35 liters/m^3) of water is typically disposed. Water that is not disposed is reused. In precast facilities there is no truck wash out/off, and water is used for product curing as steam or vapor. Around 170 gallons of water per yd^3 are used for curing while 100 gallons/yd^3 are discarded; the rest is lost as steam, and only a small amount of water is recycled.

Strict regulations on the disposal of process water produced in concrete facilities force plant managers to adopt water recycling schemes, following a trend toward zero-discharging facilities. There are two main ways to reduce fresh water

consumption and limit the generation of process water; (a) use less overall water, and (b) replace fresh water with recycled process water and captured storm water.

Reducing water usage and capturing process water can be cost effective as the use of municipal and well fresh water poses significant operational costs to concrete producers. Typical water costs range between \$0.02 and \$0.52/yd^3. Well water plants spend around \$0.07/yd^3, while plants using fresh water from municipal sources have the highest water 70 costs ranging between \$0.25 and \$0.52/yd^3 (Herbert., 2006). Recycling process water also limits the water discharge costs.

7.7 Decrease Fresh Water Usage

There are a number of measures that could be adopted to limit water consumption. The most water intensive operation is washing truck drums (50-200 gallons of water per truck). Water saving measures in this operation will have the greatest cost savings.

1. Multiple low volume drum washouts.

Using multiple low volume rinses in drum washout, reduces water consumption by 50% (Cris Argeles, 2010). One rinse of 250 gallons (950 liters) will clean a truck's drum as efficiently as a double rinse of 100 gallons (380 liters) twice, or a triple rinse of 50 gallons (190 liters) used three times (Cris Argeles, 2010). The annual savings in fresh water for an average ready mixed concrete facility can reach \$15,000.

2. Water harvesting

Aggregates during warm periods are sprayed with water to keep them cool. When the stockpiles are placed on paved and inclined areas, the runoff water at the base of the stockpile can be collected and reused in concrete batching or truck

wash out/off. Storm water can also be captured and directed to settlement basins along with process water and reused in some plant operations.

3. Water Recycling

In case study of Minnesota Technical Assistance Program, Fabcon Inc., a precast and pre-stressed concrete facility in Minnesota, to handle the increased generation of process water and the additional cost for water treatment, installed a closed loop system able to recycle all process water generated at the facility. The system was composed of series of plates to capture and remove solid particles. The recycling system provided all the water needed in the facility except for potable water. The annual savings generated from using recycled water were $160,000 and the cost of equipment was approximately $300,000 ((DPPEA). 1995).

For every cubic yard of concrete produced, around 7 gallons (35 liters/m^3) of process water require disposal (Marceau et al., 2007). By limiting process water generation, process water along with storm water can be collected, treated, and reused in concrete batching, but also in other operations (i.e. truck wash out/off), reducing the use of fresh water.

4. Create settlement basins

Settlement basins are the most prevalent way of treating process water for future reuse (Cris Argeles, 2010). Process water is collected from truck loading and cleaning areas, and is driven to a water basin system composed of a number of ground basins usually placed side by side. Process water enters the first basin and as the water volume increases, it overflows to the next one till it ends up free of solids (solids are heavier and settle to the bottom of the early basins). The basins should be properly maintained and solid wastes collected regularly. After sedimentation, water is pumped into a water tank with a minor impact on plant energy consumption.

MATERIALS AND METHODS

In this study, the status of the prevention and reduction of pollutions of ready-mixed concrete production in Yangon City, Myanmar were investigated. A questionnaire consisted of 65 questions was designed to gather information on the basic general conditions about concrete plants covering raw materials consumption, precautionary measures to lower emission levels, water and leftover concrete management, control measures for noise and air pollution including inspections and audits. These questionnaires were conducted for the total 52 CBP of (24 concrete manufacturing companies) constructed and operating plants around the Yangon City area.

From questionnaire development in every plants and site visiting of 40 plants, information of pollutions and aspects can be gathered in this research. In the sites audit, waster water from representative CBPs were collected and analyzed for pH and total suspended solids (TSS) values according EPA checklists for CBPs. After that, Planning for EMS (ISO 14001; 4.3) was shaped by evaluating Environmental Aspects and Impacts (ISO 14001; 4.3.1) of concrete production from CBP society. Every aspect are important to support effective EMS for CBPs but some significant aspects were chosen to control by priority based on Waste Minimization Policy WMP (ISO 14001; 4.3.1 b).

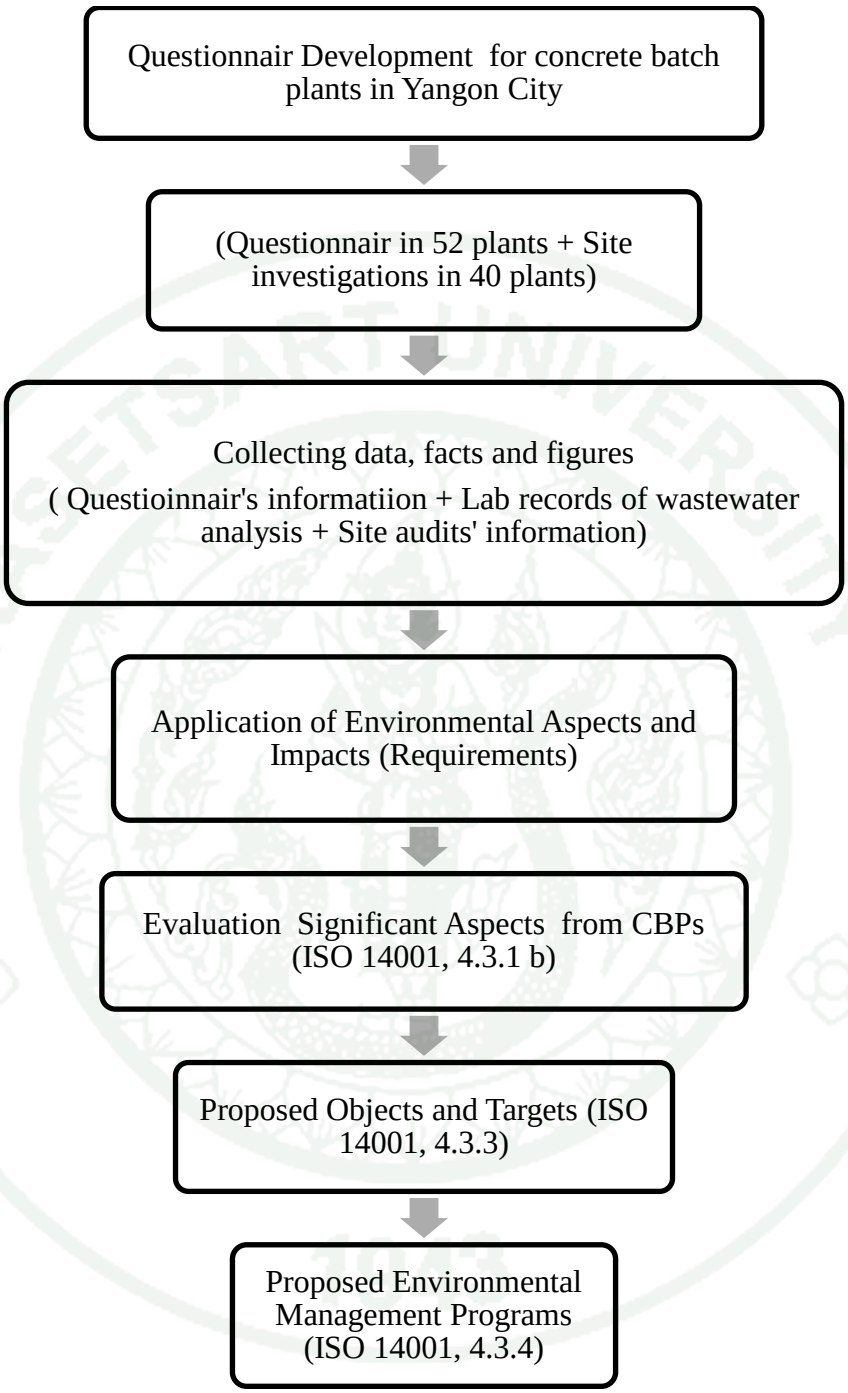


Figure 6 Flow Diagrams of Methodology

After linking the methodology steps as shown in figure 6, list of significant aspects has been assembled very important requirements that documented environmental objectives and targets (ISO 14001; 4.3.3). Environmental objective is

overall environmental goal, arising from the environmental policy and environmental target is detailed performance where practicable, applicable to the organization or parts thereof. If additional technology, equipment, staffing, etc., are needed to accomplish the tasks of CBPs, then these "mechanisms" must be supplied as environmental management programs (ISO 14001; 4.3.4).

Environmental Objectives of this research are to reduce all pollutions to zero-emission in all of pollution sources, to monitor and control the natural resources use and to develop sustainable environmental friendly CBP society in Yangon City.

Summarize Questionnaire, Answers and Results of Site Investigations

Table 10 demonstrated recapitulate facts and data of questionnaire system, audits, site investigations and lab analysis of data collection activity. This table was constructed based on 65 questions in 9 parts and these answers (results) were illustrated in results and discussion section.

Table 10 Summarize data from questionnaire system and site investigations

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
	Initial data of CBPs.						
1	Type of CBP?	52	52	100%	0	0%	All are front end loader type
2	Production rate (Amount of employees 50 to 100 people)?	52	41	79%			Medium size plant CBPs
	Production rate (Amount of employees > 100 people)?	52	11	21%			Large size plant CBPs
3	Productivity in theory?	52	41	79%			Medium size 41 plants can produce concrete 60 to 75 (m^3/ day)
	Productivity in theory?	52	11	21%			Large size 11 plants can produce concrete 120 to 180 (m^3/ day)
4	ISO14001 implementation?	52	9	17%	43	83%	9 CBPs are ready to propose ISO 14001 but other 43 plants are not ready

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
5	Waste Minimization Policy?	52	34	65%	18	35%	34 plants have quality control (QC teams) and they have individual waste minimization policy for their products as well
	Laws and Legislations.						
6	Comply with YCDC rules and regulations.	52	52	100%	0	0%	YCDC means Yangon City Development Committee (municipality)
7	Permission of disposal water?	52	14	27%	38	73%	From YCDC (authorized committee of Yangon)
8	Permission of solid waste (leftover concrete to landfill) emission?	52	6	12%	46	88%	Permission from industrial zone authority
9	At least 100 meter buffer zone from residential area?	52	52	100%	0	0%	Check the distance in plant layout drawing according EPA checklist

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
	Site location.						
10	Bunker in prevailing wind?	52	45	87%	7	13%	Check the location of bunker according EPA checklist
11	Groundwater situation in the plant's vicinity?	52	52	100%	0	0%	Shallow ground water table situated round about 15 m in all plants
12	Detract on local amenity?	52	47	90%	5	10%	90% CBP can detract surrounding areas' land price and image
13	Impact on amenity?	52	45	87%	7	13%	87% CBP disturbance privacy and health of neighboring
14	Concrete paving for controlling dust emission?	52	40	77%	12	23%	23% of CBP are very dirty.
15	Water spray for aggregate?	52	52	100%	0	0%	All CBP handles aggregates in dump condition.

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
	Air pollution.						
16	Enclose belt conveyors on top and 2 sides?	52	33	63%	19	37%	Check according EPA checklist
17	Enclose all conveyors transfer points	52	29	56%	23	44%	Check according EPA checklist
18	Enclose all free falling transfer points?	52	42	81%	10	19%	Check according EPA checklist
19	Store aggregates < 5 mm in totally enclosed structures?	52	41	79%	11	21%	Check according EPA checklist
20	Stockpiles are enclosed on at least the top and 3 sides?	52	33	63%	19	37%	Check according EPA checklist
21	Install a flexible curtain to cover stockpile entrance sides?	52	0	0%	52	100%	Check according EPA checklist

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
22	Totally enclose the ware house (for cement)?	52	52	100%	0	0%	Enclose ware house reduce dust emission.
23	Use cement bag packing system?	52	52	100%	0	0%	Big impact for workers
24	Use Cement Bulk Truck CBT?	52	0	0%	52	100%	Only one CBP ready to use CBT
25	Vehicle wheel cleaning before leaving the site?	52	44	85%	8	15%	Dry & wet washing.
26	Posted vehicle speed limits in plants' compound?	52	52	100%	0	0%	To reduce dust emission.
27	Use vegetative buffers at least 12 feet for dust prevention?	52	33	63%	19	37%	Old plants have vegetative buffers.
28	Use nylon sheet barriers for dust prevention?	52	19	37%	33	63%	To reduce wind effect

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
29	Sweep site using dry clean-up method regularly?	52	48	92%	4	8%	Housekeeping
30	Use spraying water clean-up method regularly?	52	4	8%	48	92%	Housekeeping
	Water pollution.						
31	Waste water from CBP has pH>12?	52	52	100%	0	0%	pH= 12.05 mean value ±0.6 SD
32	Waste water from CBP has TSS>200?	52	52	100%	0	0%	TSS = 193 mg/L mean value ± 47 mg/L SD
33	Direct discharge to river?	52	25	48%	27	52%	YCDC punished 25 plants because of their illegally direct discharge waste water to river
34	Direct discharge to drainage?	52	13	25%	39	75%	YCDC punished 13 plants because of their illegally direct discharge waste water to public drain (according YCDC records)

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
35	Construct and use sedimentation trap/pond?	52	14	27%	38	73%	Upgraded traditional washout processes by systematically
36	Use recycling process water in CBP?	52	5	10%	47	90%	For process water,. using CO_2 is more environmentally friendly than using chemicals (only 5 plants used process water and they used CO_2 method)
37	Use CO_2 dosage for pH reducing?	52	5	10%	47	90%	Only 5 plants used process water and they used CO_2 method
38	Use fresh water >200 gallons for one truck drum cleaning?	52	36	69%	16	31%	Monitoring fresh water use
39	Use traditional washing out system?	52	52	100%	0	0%	All CBPs used traditional washing out system but 14 plants (systematically), 38 plants (unsystematically) in their processes

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
40	Monitoring system for pH and total suspended solid TSS?	52	0	0%	52	100%	All CBPs have pH and TSS monitoring system for fresh raw water only, they do not have monitoring system for waste water discharge
	Solid waste (leftover concrete)						
41	Licensed landfill from authority organization?	52	12	23%	40	77%	14 plants are running systematically in traditional wash out and 12 plants have permission for licensed landfill
42	Illegally landfill?	52	20	38%	32	62%	YCDC punished 20 plants for illegally landfill with leftover concrete (Data from YCDC punishment record)
43	Reuse solid waste in CBP?	52	5	10%	47	90%	Use admixture (chemical) for next batch

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
44	Reproduction as road and traffic accessories?	52	6	12%	46	88%	These 6 plants are YCDC's plants (YCDC have many projects in transportation infrastructure)
45	Use in construction purpose (grouting, filling, compacting, etc,)?	52	8	15%	44	85%	These 8 plants have own housing construction projects
46	Using Reclaimer unit?	52	1	2%	51	98%	One of CBP naming Shwe Yit Wine company constructed local reclaimer unit by German technology and it has been successfully running
	Noise pollution.						
47	Use noise prevention instruments on generators and diesel engine for silent.	52	10	19%	42	81%	Sound proof technique using in exhaust pipe system of engine and generators

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
48	Noise prevention on vehicles (concrete mixed truck)?	52	46	88%	6	12%	For transit mix trucks
49	Noise prevention on conveyor belt line (sound proof)?	52	50	96%	2	4%	Top covering system for reducing noise and dust
50	Noise prevention on heavy machine (loader)?	52	33	63%	19	37%	Sound proof technique using in exhaust pipe system of heavy machine
51	Tree planted around working area?	52	38	73%	14	27%	To reduce noise and dust pollutions
	Staff training and awareness.						
52	Training for EMS and Environmental issue?	52	10	19%	42	81%	From Myanmar CBP association
53	Education for waste minimization policy?	52	34	65%	18	35%	From Myanmar CBP association
54	Seminars for sustainable CBP?	52	44	85%	8	15%	From YCDC

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
55	Workshop for Emission control?	52	47	90%	15	29%	From YCDC
56	Special staff training about toxic of admixture?	52	29	56%	23	44%	From chemical companies (especially admixtures companies)
57	Safety precaution training for operators and workers?	52	50	96%	2	4%	Individual training from separate CBPs according their point of view
	Education for EMS.						
58	Have community liaison team for claimants?	52	5	10%	47	90%	Poor (CBPs have liaisons and marking assistants for only product quality
59	Complaints from communities are recorded and investigated?	52	13	25%	39	75%	Poor (most of CBPs have poor documentation about complaint investigation)
60	Have monitoring system on resource usage?	52	0	0%	52	100%	Very poor in resource monitoring system

Table 10 (Continued)

Questionnaire and answers (2012 October 15th to 2012 November 30th)							
No	**Questions**	**TOTAL CBP**	**Answers from CBP**				**Remark**
			YES		**NO**		
			no	**%**	**no**	**%**	
61	Have single CBP law and legislation for Environment?	52	17	33%	35	67%	Based on Myanmar law
62	Measure scale of impact?	52	36	69%	16	31%	On general workers and labors
63	Public attention on CBP's pollution?	52	42	81%	10	19%	Most come from neighboring other industries
64	Do you want to run cost effective management system?	52	52	100%	0	0%	All CBP want effective EMS (but they want to use cheapest way)
65	Do you think CBP's pollutions are difficult to control?	52	0	0%	52	100%	All can be controlled in sources.

RESULTS AND DISCUSSION

The results of this research are presented in the following order; basic information of CBP in Yangon, questionnaire results, suggestions for improvements and summarizes. Since there were four main types of pollution can be observed in CBP of Yangon City, they are (1) air pollution (indoor and outdoor) (2) water pollution and (3) noise pollution and (4) solid waste pollution, recommendation for improvement were presented in the close format to ISO14001; objective, targets and program for improvements.

1. Basic Information of Yangon City and Yangon's CBPs

In last decade, Yangon City closely changed to become a business city instead of a capital. The shape and area of city were rapidly changed and enlarged within last 15 years. New industrial zones were constructed for new business and new foreign investments. Newly infrastructure constructions are needed to construct in these new industrial zone, in total 52 plants, 27 CBPs situated in industrial zones and other 25 CBPs situated in residential area especially in river bank zone. Figure 7 shows the Yangon City area (comparing 1995 and 2010).

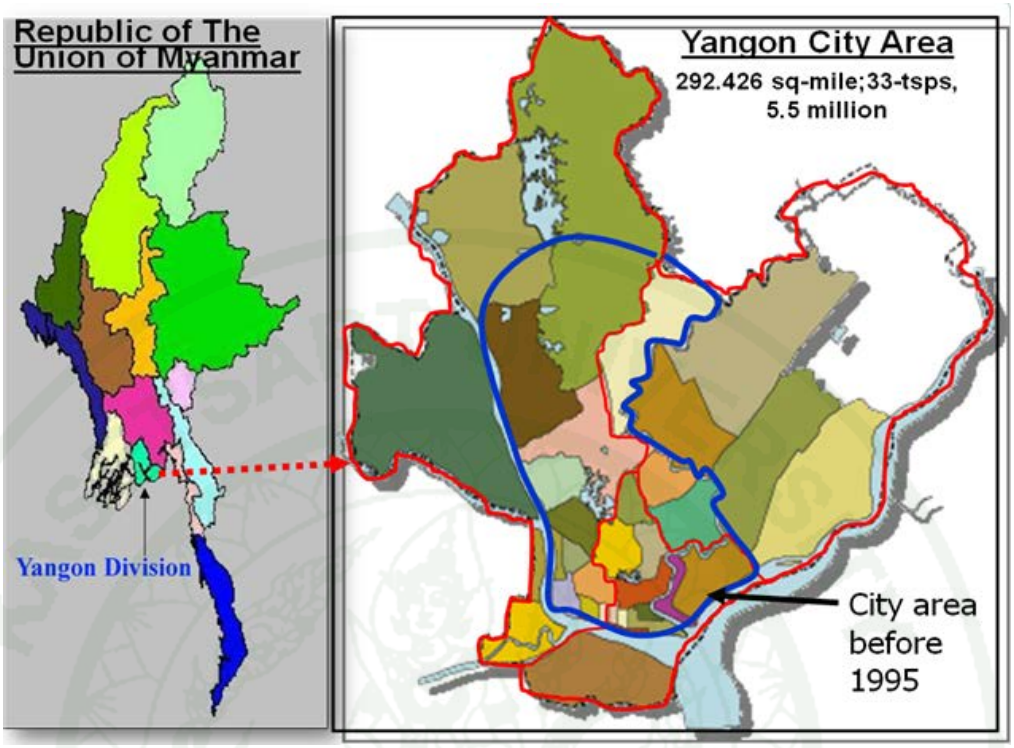
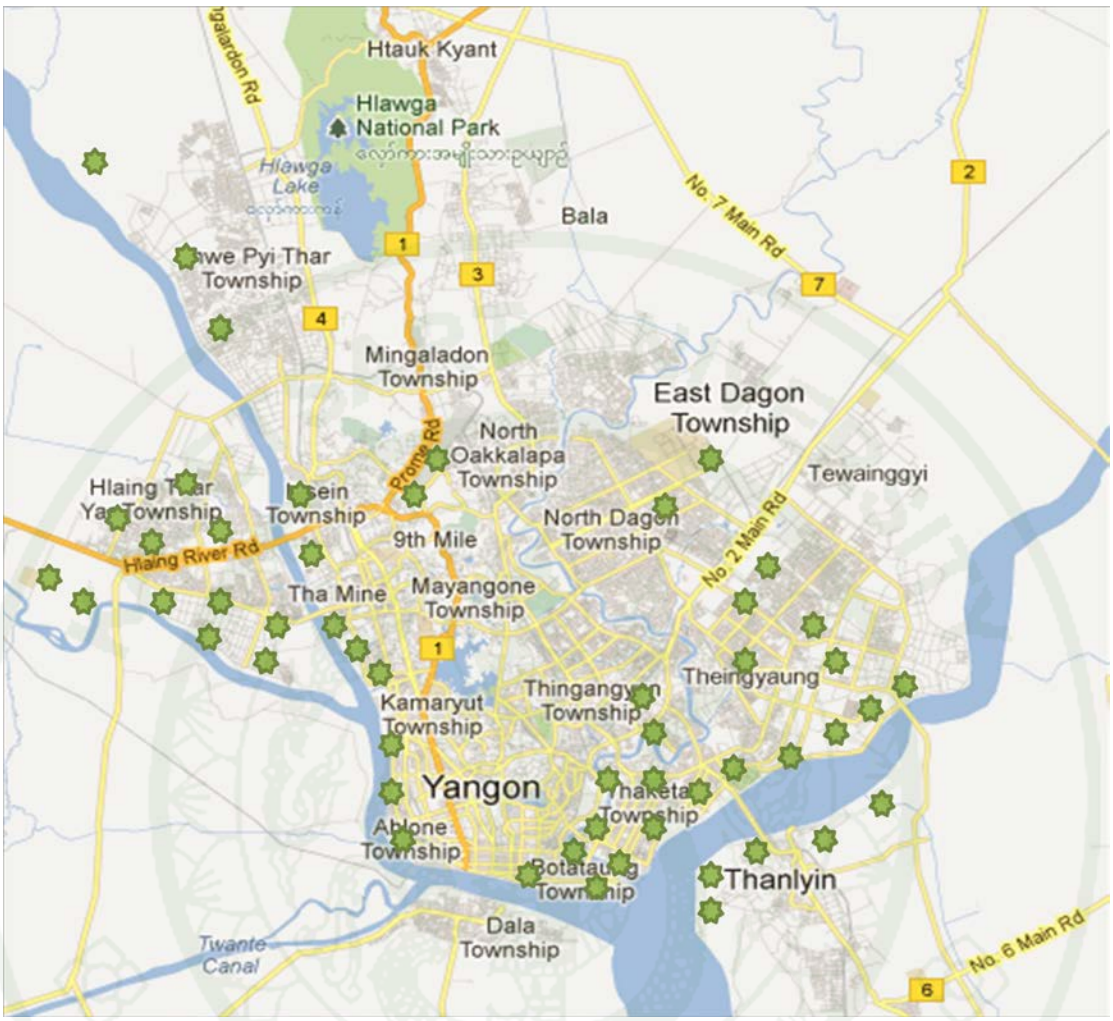


Figure 7 Yangon City Area Map

Based on field records of data collection and registration of YCDC, over 50% of CBPs were constructed along the Yangon River and raw materials (especially coarse aggregates and fine aggregates) were transported via barges. Using barges is easiest and cheapest way to accumulation main raw materials for CBPs. River water can be used for washing aggregates on site and solid waste can be used as legally landfill in river bank protection activities. But some CBPs that situated in river bank discharged their waste to river illegally. This behavior can be effected river water body pollution and can be destroyed living organism in water and endanger. Figure 8 expresses the location and total number of CBPs around the Yangon City.



Ready-mixed Concrete Batching Plant (CBP)
[Total CBP = 52 plants in 2012 November 2oth]

Figure 8 Location Map of CBP in Yangon City, Myanmar

Among the 52 ready-mixed CBP visited during the field studies, 38% are nearly 10-years old and the rest are between three to five-years old. In the ratio, 78% of the plants situated in four industrial zones, 14% located in residential areas and the remaining 8% sited in quarry areas. Most CBP to be found in industrial zones but these were not industrial estates, because all industrial zones did not have facilities and performances of industrial estates. All industrial zones have been processing under poorly management and unsuccessfully guidelines.

Industrial estates are specific areas zoned for industrial activity in which infrastructure such as roads, power, and other utility services is provided to facilitate the growth of industries and to minimize impacts on the environment. The infrastructure may include effluent treatment; solid and toxic waste collection, treatment, and disposal; air pollution and effluent monitoring; technical services on pollution prevention; quality management (quality assurance and control); and laboratory services. There should be appropriate emergency preparedness and prevention plans and liaison with local fire and emergency services. This document covers the management of activities on an established estate (WorldBank, 1995).

2. Condition of Yangon's CBPs in Environmental Point of View

In Yangon City, the plants have obtained certifications stipulated in local Myanmar rules and regulations. All CBP surveyed are members of Myanmar CBP organizations, while 17% are in the process of obtaining ISO 14001 for Environmental Management System (EMS). The other 27% and 12% were permitted to dispose waste water and other emissions by the Yangon Industrial Zone Authority. Finally, the rest of the 44% CBP are newly-constructed plants which are being checked and investigated by laws and legislations (Figure 9).

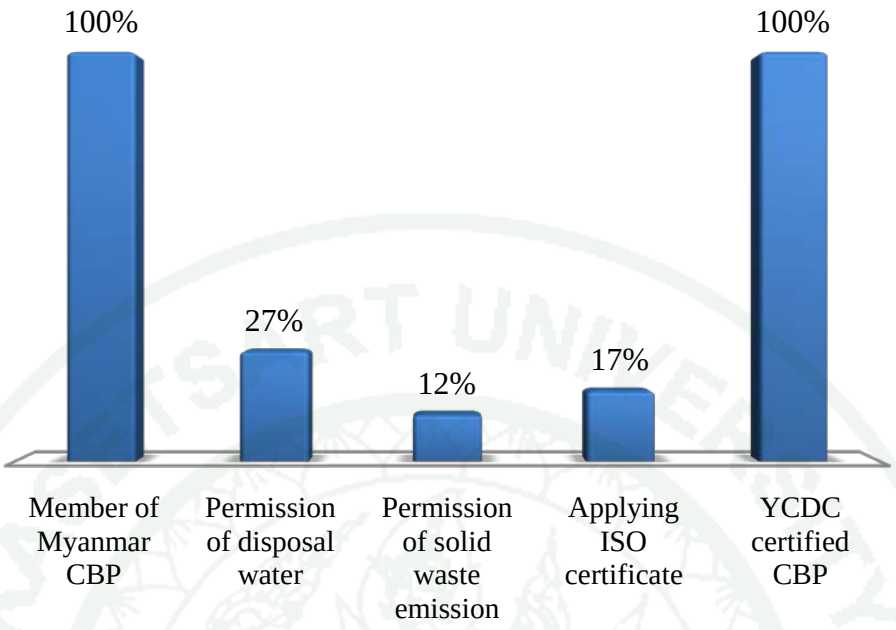


Figure 9 Certificate of CBP in Yangon City, Myanmar

(Remark: YCDC means Yangon City Development Committee)

3. Existing Environment Management at Yangon CBPs

Based on questionnaire, laboratory analysis and site investigations, the research found that pollution controls in the Yangon CBPs and their activities like as existing environmental managements of Yangon CBPs. In research, pollution control management of air pollution, dust prevention, noise pollution, waste water pollution and leftover concrete pollution was found on ground situation. The details of the findings were expressed in following tables.

3.1 Existing Air Pollution Control Management

Every CBP emits air pollutants such as dust from cement, sand and aggregates. The fine dust particles are particulate matters (PM) which enter surrounding premises and adversely affect amenity and human health, when inhaled. PM is defined as larger than 10 microns in aerodynamic diameter. Most of the PM is likely to come from vehicle traffic on the unpaved plant site. About 14% by weight of

the PM is Portland cement. Portland cement contains at least a dozen known toxic metals characteristic of material originating from the cement manufacturing. Therefore, dust must be controlled to prevent significant emissions from the plant. Figure 10 shows fundamental process of CBP and PM emissions source points.

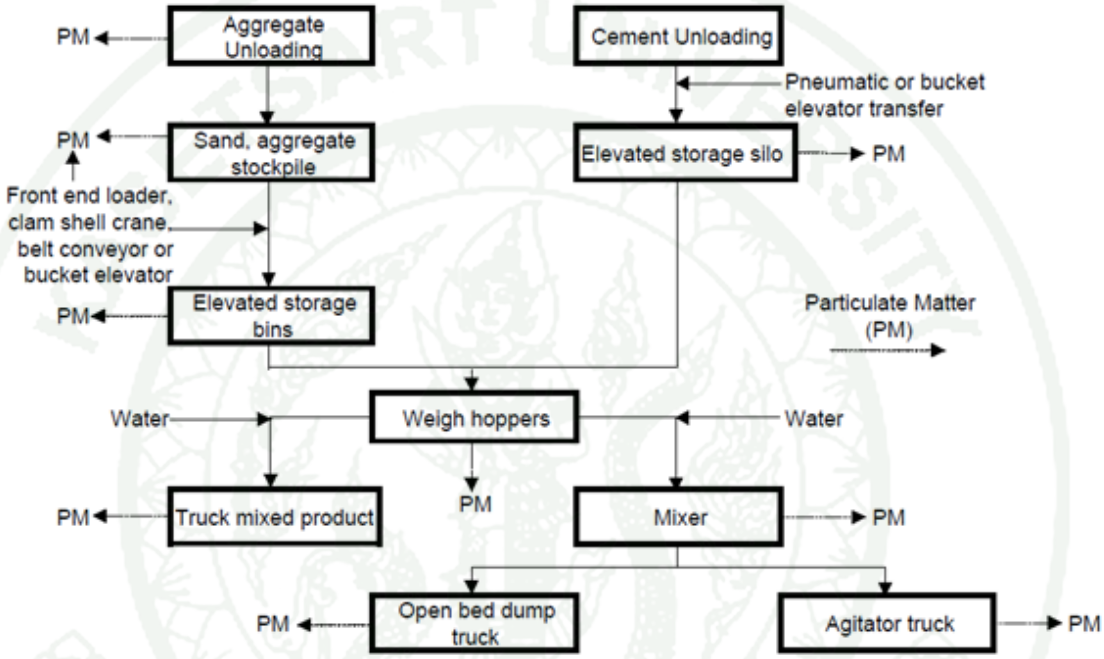


Figure 10 Basic process and PM emission of CBP (USEPA, 1995)

The potential sources of dust pollution in CBP are expressed in table 10 and discussed about controlling managements for these pollutions and existing environmental friendly activities of CBP as follow;

Table 11 Air Pollution and Control Management

Sources of Pollution	Control Management	Remark
1. Delivery of raw materials (coarse aggregates and fine aggregates)	1. Concrete paving in site	77% CBP used this method
	2. Handling all aggregates in dump condition (moisturize condition)	100% CBP used this method because aggregates were needed to wash
2. Storage raw materials in stockpiles (92% of CBP are situated in prevailing wind areas)	1. Covered with brick wall	76% CBP used this covering system
	2. Covered with landforms	24% CBP used this covering system
	3. Covered with trees	73% CBP used this covering system
3. Transfer raw materials	1. Housekeeping (dry and water spray washing)	50% CBP used this cleaning system
	2. Using cement pack store and opening system	73% CBP used this transportation system
	3. Using Cement Bulk Truck (CBT) for cement	73% CBP used this transportation system
4. Leakage or spillage of cement from cement silos	1. Effective enclosure system for cement silos	67% CBP used this control system

Based on questionnaire and field visit, dust problems were the serious impact from CBPs. Dust problems can be minimized by constructing the CBP out of prevailing high winds. The prevailing wind direction should be considered at the planning and proposal stage, to ensure that bunkers and conveyors are situated in the leeward direction to minimize effects of the wind. The provisions of natural and artificial wind barriers such as trees, fences and landforms to help control the emission of dust from the plant should be considered during the planning process.

It is important to ensure that there is no leakage or spillage of cement during either the filling or dispensing of cement from the silo. Any cement product that escapes during the filling process must be cleaned up immediately. A major issue encountered by every CBP in Yangon City is the using of cement bag during the packaging process. This is the main source of indoor air pollution in the cement storage and distribution system. To be more environmentally-friendly, cement should be transferred by airtight Cement Bulk Truck (CBT) and should be stored in enclosed cement silos. The cement weigh hopper should be totally enclosed to ensure that dust cannot escape to the atmosphere (Figure 11).

Figure 11 Indoor air pollution in cement bag sector

However, indoor air pollution of cement collection and distribution is difficult to control; it is highly dependent on the policy set under the cement storage system. If manufacturers only used cement bags in the process, indoor air pollution cannot be controlled. In spite of various air pollution prevention measures, the indoor workers will suffer from serious indoor air pollution caused by opening cement bags and distributing bags in the indoor working area.

3.1.1 Suggestion for Improvement of Management

Creating environmentally friendly and sustainable storage and distribution system of cement in CBP is suggested as an effective way to address this problem. CBP may use CBT for distribution/transportation, moisture-controlled enclosure ware houses for storing, and enclosure drill piping system for mixing with other raw materials. CBT could be used in inland industrial zone while Cement Bulk Boat (CBB) could be used in the river bank industrial zone. Another way is to draw up a contract with cement factories to sell cement only without packing and transportation.

There are three main planning procedures to minimize dust emissions from the road and the yard, which are: (1) check site layout and design for plant vicinity, loop road and compound; (2) check every vehicle for cleaning before leaving the site (dry cleaning method or putting wheel and truck washing facilities at exits); and (3) check that vehicle speed complies with the posted legal speed at the site. Furthermore, all operational vehicles should avoid from driving 25 feet of any property line, except for entry and exit to the site. Trucks transporting concrete passing by neighboring residential areas throughout the day emits dust that seriously threaten human health in those areas.

Another scope of action is to ensure enclosure of all receiving hoppers and areas for unloading materials on three sides up to 9 feet above the unloading point and to plant vegetative buffers at least 12 feet high along roads and other traffic and work areas within the specified buffer zone. In the case of housekeeping, water spray systems for dust prevention should only be used as a final measure because water sprays create a storm water issue. Dry method cleanup and wind barrier equipment should be the first choice or prioritized.

3.1.2 Summarize the Suggestion for Improvement

Finally, this study discussed at least five activities or categorical sources of PM emissions in concrete batch plants. This study identifies the following five main strategies employed by ready-mixed CBP that are in line with BPEM for air pollution.

1. PM emissions from maintaining aggregate and sand piles, material transport, and on site vehicle traffic are normally controlled by water spray method and paved plant site (Figure 12).

Figure 12 Concrete paving in CBP

2. PM emissions from loading the cementitious material are normally controlled by using Cement Bulk Truck (CBT) or Cement Bulk Boat (CBB) and by using venting to a fabric filter (bag house) for cement storage silo bins (Figure 13).

Figure 13 Cement Bulk Truck (CBT)

3. PM emissions from truck filling are normally controlled by enclosing the drop chutes and weigh hopper to minimize wind effects, and dropping the concrete components through a flexible boot that fits into the truck mixer and controlled by using three main planning approaches to minimize dust emissions from the road and yard.

4. Central mix plants: PM emissions from mixer filling are normally controlled by sucking up the PM-laden air in the vicinity of the mixer with a blower and venting it to the cement silo or an independent fabric filter.

5. Toxic air pollutant emissions from concrete batch plants are controlled by the same methods used to control PM emissions and by planting vegetative buffers within specified buffer zones.

3.2 Existing Noise Pollution Control Management

The unwanted sound can be called noise and it is also a form of pollution. Depending on the level of noise (frequency tone) and its character, disturbing effects of noise also changed. Scientifically, higher frequency tones are more disturbing than lower

frequency tones, but higher frequency tones are easily controlled and lower are not. Lower frequency tones can penetrate buildings, such as houses and ware houses.

Nonetheless, noise can cause stress in all human beings and other living things. The unit of decibels dB (A) are used in measuring sound levels and can be determined noise or not. In the unit dB(A), symbol (A) weighting of a measured sound level approximates how the human ear perceives sound, if a sound is intensified by 10 dB(A), human ears would perceive the sound to have doubled in loudness.

Noise pollution is a potential source of conflict between the operators of a concrete batching plant and the local community. So noise emission from CBP must be managed as carefully as other discharges from plant and whole process. Noise control management system should give high priority to liaising with the local community so that it can be aware of, and resolve noise pollution. Table 11 expresses existing noise pollution management of Yangon CBP.

Table 12 Noise Pollution and Control Management

Sources of Pollution	Control Management	Remark
1. Diesel engines and generators	1. Install sound proof silencers and noise absorbers	100% CBP installed this materials (because complaints from neighboring)
2. Vehicles (trucks and front end loader)	1. Install sound proof silencers and noise absorbers in vehicles	88% CBP used these sound proof materials
3. Conveyor belts	1. Enclosed with sound and dust cover along the belt line 2. Installed rubber seal and roller in belt line	96% CBP used these sound proof materials
4. Agitators (mixer)	1. Enclosed agitators in processing 2. Located sound proofing seal in agitators	62% CBP used these controlling system
5. The working areas of the whole plant	1. Planting trees and foliages to reduce noise pollution to plant's vicinity	73% CBP used this noise reducing system

3.2.1 Suggestion for Improvement of Management (All Noise Pollution Sources)

Noise pollution behaviors and major sources of CBP are shown in following figures. Practically, noise abatement can often be achieved by relatively simple noise mitigation measures in portion by portion (Figure 14 and 15).

Figure 14 Enclosed system for hopper and conveyor for noise control

Figure 15 Trees planting around the plant for noise and dust pollution

The following table 13 states the mitigation measures for noise pollution in CBP and these are very effective practically usable mitigations.

Table 13 Noise pollutions of CBP and mitigation measures

Noise Pollutions of CBP and mitigation measures		
Items	***Major noise sources***	***Mitigation measures***
Device	Hydraulic pumps	Enclose the pumps
	Air valves	Erect screens and barriers to reduce noise transmissions
	Compressors	Enclose the compressors
	Swing, scraping, loading device	Locate noisy equipments away from potential sources of conflict
	Generators	Fit efficient muffing devices to all engines
Vehicle	Front end loader and truck engi	Fit silencing devices in engine and exhaust pipe
	Truck air brakes and horns	Reducing noise of air breaks and prohibit using horn in truck
	Reverse warming devices	Use visual check for truck reverse
Operation	Public address system	Avoid public address systems for Paging staff
	Alarms (e.g., hooters, sire steam whistles)	Ensure hooters are used for emergency only and use personal paging service instead of using hooter Relocate sirens to face away from residences
	Opening and closing gates	Use liner or sound absorbing materials such as rubber
	Radios and amplified telephones	Use pager for communication

Table 13 (Continued)

Noise Pollutions of CBP and mitigation measures		
Items	***Major noise sources***	***Mitigation measures***
Process	Aggregate delivery to bunk and hoppers	Weight fine aggregates before coarse aggregates Use self cleaning weigh hoppers Use rubber liner in hopper
	Filters for separating	Position access and exit points away from noise sensitive area
	Conveyor belt	Enclose conveyor belt and use rubber liner
	Agitator process	Locate noisy equipment away from Potential sources of conflict

3.2.2 Suggestion for Improvement of Management (for Working Hour Only)

For working hour's schedule, operations should be limited between 7 am and 6 pm Monday to Friday and 7 am to 1 pm on Saturday. But many CBP run their operation in fully loaded 24 hours, if they accepted huge amount with fixed due date. So it is emergency need to announce noise limitations for various types of land uses because CBP can be constructed in different locations in the City area. This following table 13 is adapted from EPA publication and expressed typical noise limits for various types of land uses.

Table 14 Noise limitation for various types of land uses

	Noise limits dB(A)		
Land use	Monday to Friday 7am-6pm Sat 7am-1pm (excludes public holidays)	All nights 10 pm-7 am	All other times
Quiet rural areas	45	32	37
Mainly residential	50-54	39-43	44-48
Residential, commercial and industrial	54-59	39-43	48-52
Commercial and industrial	56-59	47-52	52-58
Industrial	63-68	52-56	57-61

Source: (EPA)

3.3 Existing Water Management and Pollution Control Management

The purpose of water management in CBP is to reduce the consumption of water, prevent water pollution and dispose of the waste water in accordance with disposal limits without harming the environment. Nowadays, process and storm water management at CBP is growing issue for Yangon CBP industry. Process water of CBP in the range of pH 6-9 and 50-200 parts-per-million total suspended solids (TSS) is deal for re-use in batching, washing and rinsing. Monitored process water pH and TSS to ensure these ranges are met for rinsing water to be re-used for batching and can be treated CO_2 dosage and using sedimentation pond.

In the research, process water samples from representative 24 plants were collected and sent to ISO lab and analyzed. According from lab results, all of pH and TSS values were greater than 11 and 200 mg/L respectively (pH= 12.05 ±0.6 SD and TSS = 193± 47 SD). But only 27% of Yangon CBP constructed and used sedimentation traps and ponds for control pH and TSS value of process water, and among them only 10% sendimentation traps installed CO_2 dosing method and system to reduce pH level. So research can be concluded only 10% of CBP backward used process water for new fresh concrete production in systematically process. The other 48% of CBP direct discharged their waste water to Yangon river and left 25% of CBP discharged their waste water to industrial zone drainage system directly (Figure 16).

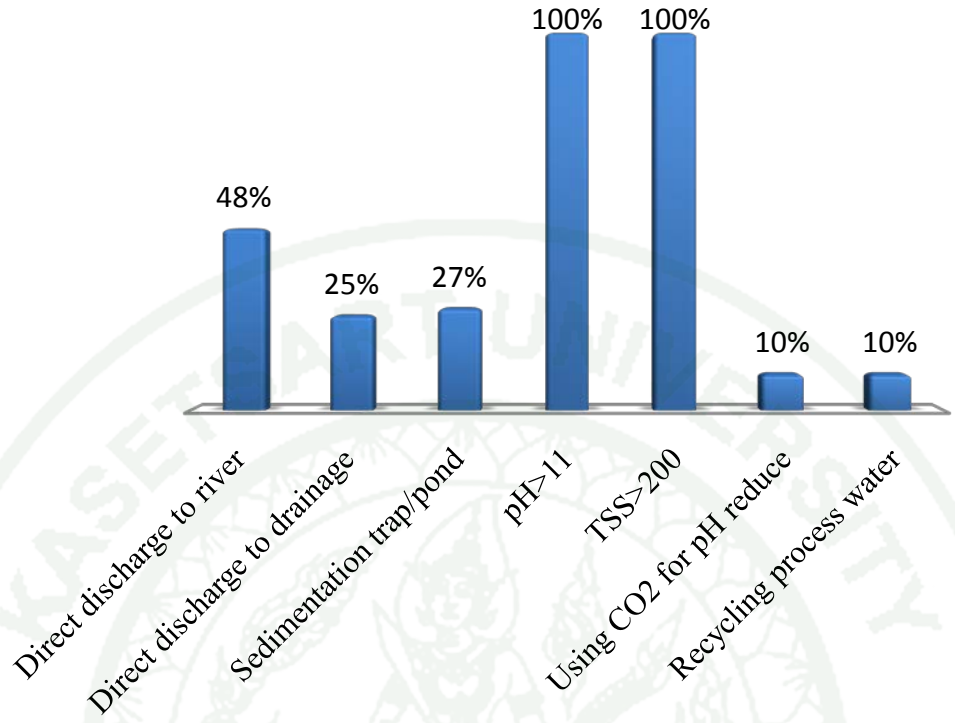


Figure 16 Waste water analysis qualities and management of CBP in Yangon City

3.3.1 Suggestion for Using Process Water

This behavior that using process water is big challenge for today and every CBP should be familiar with requirements governing the discharge of process water. Because process water is often related to washout and coring operations but it may also include storm water, which collects a measurable amount of cementitious material from areas surrounding the production facility. Concrete process water is caustic and typically has a high pH value ranging between 11 and 12. It contains dissolved solids including sulfates and hydroxides from cement, oil and grease from equipment and derivatives from chemical admixtures.

The Canadian Department of Fisheries and Oceans says that the effects of high pH on fish may include death; damage to outer surfaces such as gills, eyes and skin; and the inability to dispose of metabolic wastes. In addition, the high content of total suspended solids (TSS) typically found in process water may clog a fish's gills,

destroy natural breeding areas, affect a fish's ability to feed and create an overall imbalance in the surrounding environmental habitat.

But using sedimentation pond and dosing CO_2 can be reduced pH and TSS levels. According from lab result, pH and TSS values reduced to 7.6 to 70 mg/L respectively. ASTM specification C-94 permits the use of wash water from mixer washout operations for mixing fresh concrete, as does Portland Cement Association (PCA) (10) standards. Referable literature and laboratory results indicated that concrete batched from process water strength-tests equal to, or greater than, concrete made using fresh water. In Yangon City, one of systematic sedimentation pound was constructed by German technology for process water (figure 17).

Figure 17 Sedimentation pond for process water

3.3.2 Suggestion for Controlling Waste Water Discharge

So water management and waste water control system of Yangon CBP must be stipulated by Laws and Legislations that related to Myanmar Environmental Conservation Law. For examples, the U.S Environmental Protection Agency (EPA) monitors and limits the nature and magnitude of waste products a site is allowed to discharge into the waters of the United States, while local sanitary and sewer

authorities set the limits for total suspended solids, pH and chemical composition for process water discharged into local sanitary sewer systems. In Thailand, the enhancement and Conservation of National Environmental Quality Act .B.E (A.D.1992) empowers the Ministry of Science, Technology, and Environment to issue emission or effluent standards for the control of wastewater discharge and the discharge of wastes into public waters.

In Thailand Enhancement and Conservation of National Environmental Quality Act, B.E.2535 include the section 91 “Any owner or possessor of the point source of pollution required by section 70 to have an on-site facility for wastewater treatment or waste disposal, who illegally discharges wastewaters or wastes into the central wastewater treatment plant or the central waste disposal facility of the public service, shall be liable to pay as a daily penalty four times as much the amount of daily expenses for the normal operation of his on-site facility.

3.4 Existing Solid Waste Management

The conventional methods for the disposal of concrete wash water include dumping in Yangon City are (1) at the jobsite (2) at a landfill (3) into a reclaimer/recycle unit (4) into a concrete wash water pit (5) in the ready-mix plant yard. The removal of hardened residual wash-out can result in expensive labor costs, excessive wear and tear on front-end loaders, and costly hauling charges. As local regulations, enforcement municipality legislations and Myanmar Environmental Conservation Law, discharging from plant sites evolve, the option of reusing the sources of solid wastes will become a necessity, thus moving the industry toward zero-discharge facilities.

The main intention of solid waste management is to reduce the amount of leftover concrete, recover the actual leftover concrete and appropriately dispose of the material not suitable for recovering. This is effective practice way and pollution can be prevented and the resources saved. But the most important subject matter on left over concrete management is the correct calculation of the amount of the necessary concrete, thus preventing the generation of leftover concrete. If operator or engineer

calculated wrong amount of necessary concrete, setting time of concrete and transportation time, concrete will be set in drum and it will be damaged.

In this field study, the method of using the leftover concrete in the production of another construction materials purpose was observed in 15% of CBP in Yangon City. Only 2% CBP was observed that have systematic concrete reclaimer unit like a pioneer. Reclaimer unit in CBP is innovative methods for recycling left over concrete and treating concrete process water. Another 10% CBP reused leftover concrete in their reproduction process in plant and this unsystematic process can affect concrete strength. The other CBP put their leftover concrete to settling pit and extracted from the settling pit is dried, 23% transferred to the municipality landfill as licensed landfill and 38% dumped by the side of the roads and unused private/public areas as illegally landfill (Figure 18 and 19).

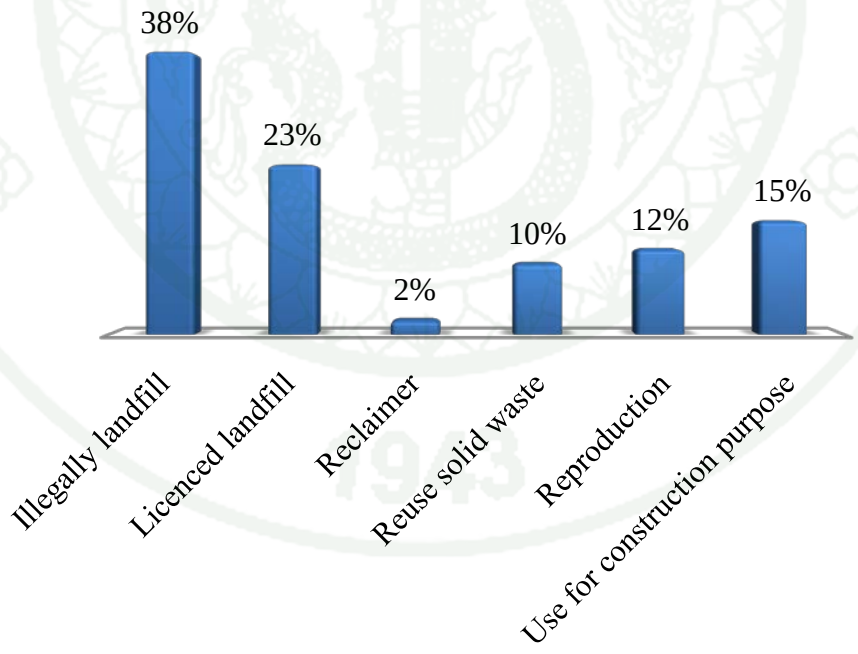


Figure 18 Solid waste management of CBP in Yangon City

Figure 19 Reused leftover concrete in road construction purpose

3.4.1 Suggestion for Using Reclaimer Units in Yangon CBPs

Former researches expressed that, at the end of each day, when a 7.0 cubic meter ready-mix truck returns to the CBP with no leftover concrete, that truck will contain approximately 350 kg of cement, fine aggregate and coarse aggregate adhering to the inside of the truck drum. It is a common practice in the ready-mixed concrete industry to wash this residue out using approximately 600 to 2000 liters of water to thoroughly clean the inside of the drum. Solid waste management also big issue for EMS of every CBP.

This study was intended to simulate a practical situation where includes a returned concrete reclaimer that generates recycle concrete waste and water slurry. The concrete reclaimer system can recycle perfect sand and aggregate purification effect with less than 0.5% remaining cement. In practically, sand (fine aggregate), aggregate (coarse aggregate) and the concrete water mixture can be reused without problems. Testing ordinary type concrete reclaimer in Yangon City can wash continuously maximum 40 ton/hour and it can reduce concrete waste, gain sand and aggregate and waste water also can be used as aggregate washer. The performance of concrete reclaimer is zero discharge or zero emissions.

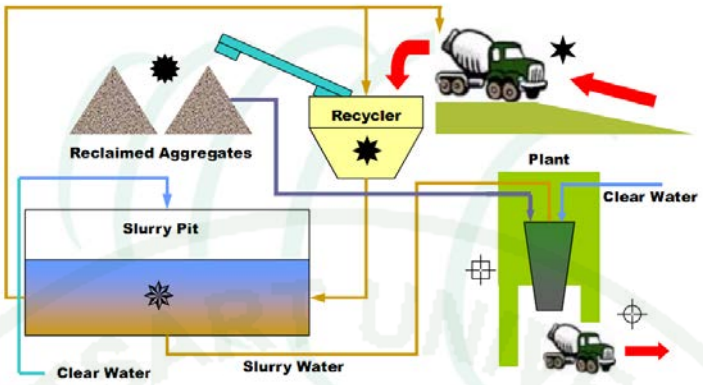


Figure 20 Process flow diagram of basic reclaimer unit

In the main structure of reclaimer system, the machine is consisted of three systems such as: separation system water supply system and electric control system. Basically, stones separation and sand separation systems are together installed as focal. Separation system and it is mainly consisted of the feeding flume (scarf) stone separator, sand separator frame and screen off-stone system. The submerged pump, sewage pump and spraying pipe are mainly included in water supply system an electric control box (manual or automatic) and cable are included in electric control system that controlled switch on and off action in motor and valve under the operation procedure.

Figure 21 One of reclaimer unit in CBP of Yangon City

In the processing of the reclaimer system, agitating lorry is driven onto the slope cleaning platform and cleaned with water firstly, after that the waste materials from the agitating lorry are rushed into the feeding flume and come into the inlet of the Concrete Recycling Plant to get separated through rotating screen. The separated stones and sand will be carried out from different outlets finally. After precipitating for several times, the muddy water which overflows out will be taken back for recycling, to make zero drainage of waste water.

3.4.2 Suggestion of Using Chemical Admixtures in Yangon CBPs

The American Concrete Institute (ACI) defined admixtures and American Society for Testing Material (ASTM) set the standard of admixtures.

ASTM C260- Air-Entraining Admixtures

ASTM C494-

Type A- Water-Reducing

Type B- Retarding

Type C- Accelerating

Type D- Water-Reducing & Retarding

Type E- Water-Reducing & Accelerating

Type F- High-Range Water-Reducing (HRWR)

Type G- HRWR & Retarding

ASTM D98- Calcium Chloride

ASTM C869- Foaming Agents (for use in making Cellular Concrete)

ASTM C1141- Admixtures for Short creep

ASTM C1017- Admixtures for Use in Producing Flowing Concrete

ASTM C979- Pigments For Integrally Colored Concrete

Some of admixtures in above types of admixtures are used in Yangon's CBP and other types of admixtures, (1) Micro silica-ACI 234R, (2) Corrosion Inhibitors, (3) Shrinkage Reduction, (4) Hydration Stabilizers and (5) Flow able Fill Additives, which are not listed in ASTM specifications, are also used in concrete manufacturing. Most admixtures are metered or measured into the mix in fluid ounces per 100 pounds of total cementations, and they are manufactured based on sugar cane and wood. Recent literature said, using sugar or wood-based admixtures that are safer and less toxic than other chemical concrete additives.

3.5 Discussion about Education Awareness of Yangon CBP

The managers, engineers and other technical staff who run the concrete production of CBP must believe in their importance methods and routines that lessen the environmental impact of their daily activities. Awareness for environmental protection is achieved via educational seminars, workshops and trainings dealing with these methods and routines.

According from field results, it was determined that environmental management knowledge exists especially at only 19% of CBP. It was also determined that education for Waste Minimization Policy WMP is provided in 65% CBP. Within last 3 years, other 85% CBP participated in environmental seminars, 90% CBP held

workshops for emissions control and 56% CBP invited chemical specialists from admixture companies for staff trainings in admixture usage (Figure 22).

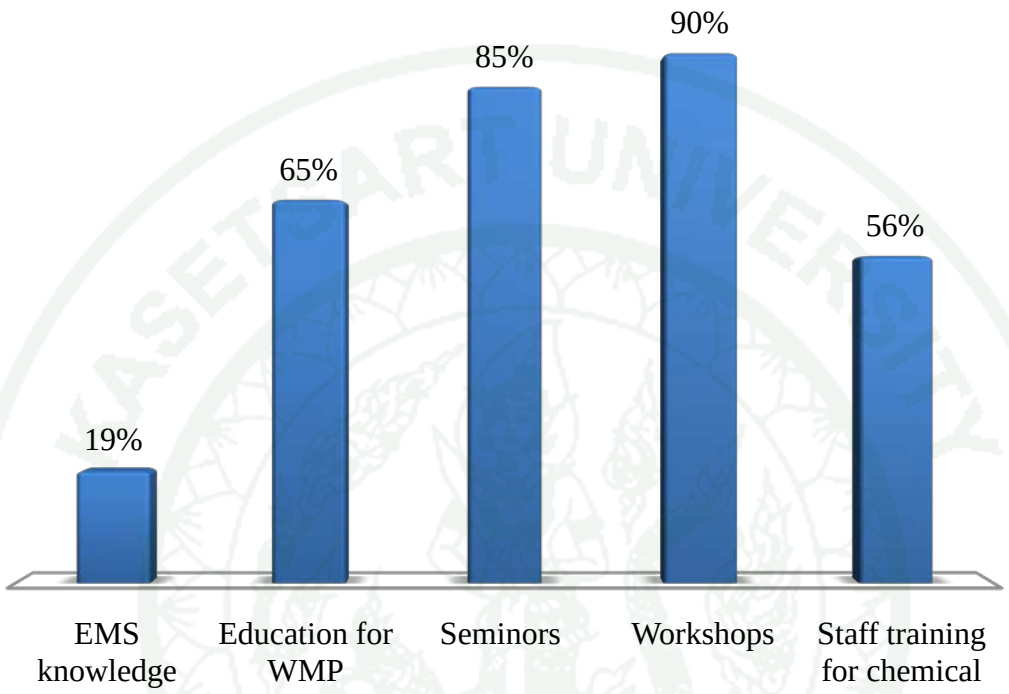


Figure 22 Staff training and education for EMS of CBP in Yangon City

EMS (ISO 14001) FOR YANGON CBPS

According questionnaires, audits and field investigation results, this research can be evaluated on all environmental aspects of fully batching process by one of evaluation ranking system. In ranking system, there are two main evaluation criteria based on (pollution aspect) and (resource use). They are expressed in literature review at **Table 1** Environmental Aspect Evaluation Criteria (Pollution Aspect) and **Table 2** Environmental Aspect Evaluation Criteria (Resource Use).

According this ranking system, the research evaluated the whole process of concrete production from accumulation of basic raw materials step to management of leftover concrete that final step in portion by portion. Every step was based upon turning points of emission to surroundings and fundamental regular process of concrete industry. From the evaluation rank list, results can be concluded the top worst three activities for environment.

Table 15 Evaluation of Environmental Aspect

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
1	Accumulation raw materials (FA & CA)	**1.1** Delivery to ground storage (using front end loader)	**N**	1	5	4	1	0	0							11	**6**	**[Impact] [Emission (PM, CO_2, Noise)]** (FA & CA are partially wet) (happen all time) (CO_2 can cause global warming)
		1.2 Washing aggregates	**N**							0	4	0	0	1	0	5	**10**	**[Impact] [Using (Large amount of water)]** **(**weakness in monitor) (washing FA & CA, >50% total wash water)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
1	Accumulation raw materials (FA & CA)	**1.3** Transfer aggregates to conveyor (using front end loader)	**N**	1	5	4	1	0	0							11	**6**	**[Impact] [Emission (PM, CO_2, Noise)]** (FA & CA are totally wet) (happen all time) (CO_2 can cause global warming)
		1.4 Transfer aggregates to elevated storage (using conveyor)	**N**	1	5	0	1	0	0							7	**9**	**[Impact] [Emission (PM, Noise)]** (Emission can be mainly controlled by using cover & rubber seal) (happen all time)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
2	Accumulation raw materials (Cement)	**2.1** Unloading cement bags to warehouses, opening bags and delivery by screw conveyor	**A**	4	5	5	4	2	4							24	**2**	**[Impact] [Emission (PM)]** (severely endanger for employees) (can't be controlled) (violate requirement)
		2.2 Unloading cement to elevated storage silo (by using pneumatic or screw transfer)	**N**	1	0	0	1	0	0							2	**11**	**[Impact] [Emission (PM)]** (Emission can be mainly controlled by using air tight seal)(have legal control and comply with requirement)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
3	Fresh concrete product-ion	**3.1** Weighing hopper loading (Aggregates and cement)	**N**	0	0	0	1	0	0							1	**12**	**[Impact] [Emission (PM)]** (legal control, comply with requirement)
		3.2 Adding fresh water and admixtures	**A**							1	2	0	0	4	2	9	**8**	**[Impact] [Using (Large amount of water)]** (legal control for water usage by municipal) (incomplete equipments) (all water can't be reused) (impact in local zone)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
3	Fresh concrete product-ion	**3.3** Mixer loading	**N**	4	5	1	0	0	0							10	**7**	**[Impact] [Emission (Noise)]** (noise can't be control) **(**noisy operation all the time) (claim from employees in site)
		3.4 Transit mix loading (Truck using fossil fuel)	**N**	4	5	5	0	0	0							14	**4**	**[Impact] [Emission (CO_2, Noise)]** (noise, CO_2 can't be control) **(**noisy and smoky operation all the time)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
4	Transportation concrete paste products to end users	**4.1** Driving AG trucks (using fossil fuel)	**N**	1	5	6	1	1	1							15	**3**	**[Impact] [Emission (PM, CO_2)]** (pollution mainly controlled) **(**many trucks, pollution happen all the time) (global warming and claim from nearby companies)
		4.2 Washing trucks' wheel and plant's pave	**A**							1	2	0	0	4	2	9	**8**	**[Impact] [Using (Large amount of water)]**(legal control for water usage by municipal)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
5	Management of leftover concrete	**5.1** Using reclaimer unit (CO_2 dosage)	**N**	0	0	0	0	0	0							0	**13**	**[Impact] [Emission (Zero 100% recycled)]** (most best method for leftover concrete but unit is more expensive than only reusing process water) (for long term, reclaimer unit is cost effective treatment)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
5	Management of leftover concrete	**5.2** Washing returned AG trucks' drums on plants	**A**							1	2	0	0	2	2	7	**9**	**[Impact] [Using (Large amount of water)]** (legal control for water usage by municipal) (incomplete equipments) (10-50% of water can be reused) (impact in local zone's water supply system and cause water shortage)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
5	Management of leftover concrete	**5.3** Direct discharge to public drain or river	**A**	4	5	8	3	3	3							26	**1**	**[Impact] [Emission (Water pollution and solid waste)]** (pollution can't be controlled) (happen all the time) (can destroy living organism in water and claim from public) (mostly comply) (severe health problem) (high attention)

Table 15 (Continued)

No	Process (Activity)	Environmental Aspect	N/A/E	Criteria for Evaluation												Score	Rank	Remark
				Pollution						Resource Use								
				1	2	3	4	5	6	1	2	3	4	5	6			
5	Management of leftover concrete	**5.4** Illegal landfill and dump in public area	**A**	4	3	3	2	0	1							13	**5**	**[Impact] [Emission (Water pollution and solid waste)]** (pollution can't be controlled) (15-20 time a year) (cause long term impact in land use) (rarely violate) (low attention)

N= Normal situation

A= Abnormal situation

E= Emergency

In this research, Environmental objective is overall environmental goal, arising from the environmental policy and environmental target is detailed performance where practicable, applicable to the organization or parts thereof (ISO 14001; 4.3.3). If additional technology, equipment, staffing, etc., are needed to accomplish the tasks of CBPs, then these "mechanisms" must be supplied as environmental management programs (ISO 14001; 4.3.4).

Environmental Objectives of this research are to reduce all pollutions to zero-emission in all of pollution sources, to monitor and control the natural resources use and to develop sustainable environmental friendly CBP society in Yangon City. Table 16 illustrates the top three emergency worst aspects of concrete batching in Yangon City and the following steps proposed targets (detailed performance) for these emergency cases. Environmental management programs were also expressed in these discussions.

Table 16 The top three worst significant aspects in concrete batching in Yangon CBPs

No	Process (Activity)	Environmental Aspect	Environmental Impact	Remark
5	**Rank 1** Management of leftover concrete	5.3 Direct discharge to public drain or river	**Emissions** (Water pollution and solid waste)	(pollution can't be controlled) (happen all the time) (can destroy living organism in water) and claim from public (mostly comply) (severe health problem)
2	**Rank 2** Accumulation raw materials (Cement)	2.1 Unloading cement bags to warehouses, opening bags and delivery	**Emissions** (PM)	(severely endanger for employees) (can't be controlled) (violate requirement)
4	**Rank 3** Transportation concrete paste products to end users	4.1 Driving AG trucks (by using fossil fuel)	**Emissions** (PM, CO_2)	(pollution mainly controlled) (so many trucks, so pollution happen all the time) (global warming and claim from nearby companies)

Suggestion for Significant Aspect (Rank 1)

The management of leftover concrete has many problems and some activities are difficult to control the pollution. In point of risky view, direct discharge waste water and leftover concrete to public drainage system and river is the worst behavior and this is so dangerous for surrounding areas. Because pH level of CBP waste water is normally higher than 12 and this amount can destroy living organism in water and endanger for water users.

Table 17 Summarize suggestion for significant aspect (rank 1)

No	Title	Summarize	Remark
1	Environmental Targets	1.To reduce leftover concrete wastes 2. To reduce pollution to zero emission and to reuse all of concrete waste	(ISO 14001; 4.3.3)
2	Environmental Management Program "mechanisms"	1.To choose better solutions for leftover concrete wastes from basic 4 methods (a) traditional washing out system (b) chemical wash out system (c) stoning out system (d) reclaimer system. 2. To seriously prohibit illegally discharge waste water and leftover concrete to drain, river and surroundings by laws and legislations	(ISO 14001; 4.3.4)

In this significant aspect, the *environmental objective* (ISO 14001; 4.3.3) is to reduce leftover concrete waste and pollution to zero-emission and to reuse all of waste materials from leftover concrete. Around the world, there are very basic four types of cleaning mixer truck for leftover concrete, naming (1) traditional washing out system, (2) Chemical wash out system, (3) Stoning out system and (4) Reclaimer system. The cleaning system that naming traditional system has being used in Yangon CBPs, but this system produces cementitious slurry which is increasingly expensive to dispose of. And this process requires extensive yard space and takes a long time to drain waste. Another cleaning and recycling system naming chemical wash out system also needs relatively high ongoing costs and skillful training for chemicals.

So the *Environmental Management Program* (ISO 14001; 4.3.4) or "mechanisms" are stoning out system and reclaimer system for developing countries especially Myanmar. In stoning out system, all materials can be reused and the whole

process is inexpensive, but this system requires large ground storage and is not suitable after a minority of mixes. Using reclaimer system, the CBPs need to invest enough amount of budget and to study effective modern techniques to reduce pollutions and reduce resource use. Using reclaimer unit or recycle unit can reduce pollutions to zero-emission theoretically and practically but it is needed to use huge amount of money for first investment. Normally reclaimer unit is more expensive than only reusing process water by sedimentation ponds/traps. Its price can change depend on its operation system and brand. Although first investment is expensive, CBP can be reduced their waste money from leftover concrete waste. So reclaimer system is most suitable process to control pollutions and resource use.

Suggestion for Significant Aspect (Rank 2)

Using cement bags packaging system is emergency situation to pollute the environment and another emergency situation of Yangon CBP. This system can be caused lung cancer for general workers severely because of indoor air pollution. Normally working space for opening cement bags is narrow and only indoor system for protection weather effect, and this pollution cannot be control in source area. The main pollutant in this air pollution is cement dust. In combination, a mixture of oxides of calcium, silicon, and aluminum are consisted in cement. Alkaline substances, including cement, can cause serious burns to human skin and respiratory system problems.

Table 18 Summarize suggestion for significant aspect (rank 2)

No	Title	Summarize	Remark
1	Environmental Targets	1.To reduce indoor air pollution (especially cement dust pollution) 2. To reduce using cement bags and to get social economic benefits	(ISO 14001; 4.3.3)
2	Environmental Management Program "mechanisms"	1.To choose Cement Bulk Truck for inland CBPS and to choose Cement Bulk Boat for river bank CBPs 2. To use pneumatic transfer or screw conveyor for transferring to enclosed silo	(ISO 14001; 4.3.4)

The *environmental target* (ISO 14001; 4.3.3.10) for this significant aspect is to reduce cement dust pollution (indoor pollution) to zero-emission and to establish "vision" statement of the CBP organization and to manage detailed "work-plan" for unloading cement process. Research can be concluded that cement should be accumulated by air tight Cement Bulk Truck (CBT), train or Cement Bulk Barge (CBB) and pneumatic transfer or screw conveyor for transferring to enclosed silo. In this process or vision changing, very important *Environmental Management Program* (ISO 14001; 4.3.4) is managing and dealing between CBPs and cement factories. Special order or win-win agreement or welfare contract can be achieved to solve this pollution problem.

Suggestion for Significant Aspect (Rank 3)

Another most polluted activity for CBP is transportation system and network for distribution fresh concrete to end users. In this process, there are many agitator trucks produced CO_2 and dust emissions along the routines tracks. So this activity can be effected air pollution and especially spread wheel dust to the city roads in poorly control or management system. The *environmental target* (ISO 14001; 4.3.3.10) for

this significant aspect is to reduce CO_2 emission and yard-road dust pollution around the city. The effective way to reduce CO_2 emission is choosing shortest way to distribute fresh concrete, using renewable energy in mixer trucks and maintaining trucks' exhaust system.

Table 19 Summarize suggestion for significant aspect (rank 3)

No	Title	Summarize	Remark
1	Environmental Targets	1.To reduce CO_2 emission from agitator trucks for concrete distribution 2. To reduce dust emission from yard and roads cause of processing and transportation	(ISO 14001; 4.3.3)
2	Environmental Management Program "mechanisms"	1. To create effective dry and wet washing clean system for every truck before leaving from CBP 2. To keep continuously housekeeping activity in all working areas 3. To check site layout-track design and post vehicle speed limits also to solve the dust pollution from CBPs	(ISO 14001; 4.3.4)

Best solution to reduce yard-road dust pollution is house-keeping and washing system for trucks, trucks' wheels and yards. But this is difficult to clean many come in-and-out trucks and busy working yards and streets forever. And this cleaning system can be wasted many gallons of fresh water in unsystematic control system. So every CBP should be created effective dry and wet washing clean system for every truck before leaving from CBP and reduced or monitored in using water with water meter or gauge. Another checking system for site layout-track design and posting vehicle speed limits also can be supported to solve this pollution.

CONCLUSION AND RECOMMENDATION

Conclusion

CBP in Yangon City require a clear framework or EMS to address the challenge of moving toward a sustainable society and environment. It is observed that most plants still do not implement effective EMS, though some are beginning to introduce such frameworks. Drawing from EPA guidelines/checklists complying with ISO 14001, this paper recommends the following: changing storage and distribution systems of raw materials (especially for cement in terms of air pollution), setting practical self-control activities and installing dust control systems for lowering air pollutant emissions to be adopted as effective BPEM for Yangon City. Although this requires some additional investment and would also cause some inconveniences, through the BPEM approach CBP may reduce their immediate negative impacts to the environment and society, while improving business profitability and sustainability through cost savings and other benefits in the long term. It is hoped that this paper's findings will be of direct relevant to CBP, in terms of improving Yangon City's environment and helping realize sustainable development for future generations.

This EMS will assist the all CBP's owners in their operation of concrete batching plant to:

1. Act in accordance with the legislative requirements of YCDC Law and Myanmar Environmental Conservation Law

2. Categorize potential environmental problems and to monitor and resolve these problems

3.Understand the plant management EMS(ISO 14001) and plant's responsibilities

4. Apply and maintain appropriate technology to minimize the pollutions, wastes and impact of their operations on the environment

Another big issue of Yangon City industrial zone is incompletion of industrial estate facilities, and it is emergency need to evaluate industrial estate development today.

Recommendation

Industrial Estate Development

In the research, CBPs in Yangon City were listed 52 plants and they are separately situated along in 24 industrial zones, residential areas and quarry areas. Most CBP situated in industrial zones but there are not industrial estates, because all industrial zones did not have facilities and performances of industrial estates. All industrial zones have been processing under poorly management and unsuccessfully guidelines.

Industrial estates are specific areas zoned for industrial activity in which infrastructure such as roads, power, and other utility services is provided to facilitate the growth of industries and to minimize impacts on the environment. The infrastructure may include effluent treatment; solid and toxic waste collection, treatment, and disposal; air pollution and effluent monitoring; technical services on pollution prevention; quality management (quality assurance and control); and laboratory services. There should be appropriate emergency preparedness and prevention plans and liaison with local fire and emergency services. This document covers the management of activities on an established estate (WorldBank, 1995).

In first priority, selection of sites for industrial estates should take into account social and environmental issues, as well as economic considerations. So the key issues are emergency needs to develop Yangon City industrial zones becoming fully loaded industrial estates. Industrial estates should preserve safe distances from residential

areas (for example, 100 meters for small industries with minimal environmental risk and at least 1 kilometer for very polluting industries).

Description of institutional responsibilities is an essential component of a development plan and the key environmental issues to be addressed in the development plan should be identified through an environmental assessment process. The big issue of reconstruction or modernization of unsystematic old industrial zones is mixing of numerous types of industries on the site. So it is need to ensure that the industries are compatible-for example, that neighbors of CBP do not pose food processing plants.

Nowadays Myanmar government already has been changed investment policy and laws and legislation, and has been inviting foreign investments. But facilities, treatment systems and emissions guidelines or standards are still poor in all of industrial zoning areas. In Myanmar Environmental Conservation Law also described to stipulate environmental quality and emission standards. The followings are commonly useful emissions guidelines for every industrial estate around the world.

Table 20 Air Emissions from Facilities in Industrial Estates *(milligrams per normal cubic meter)*

Parameter	Maximum value
PM	50 for large facilities Up to 150 for small facilities with energy consumption of less than 10 gigajoules per hour (fuel used)
Nitrogen oxides	750 (solid fuels) 460 (liquid fuels) 320 (gaseous fuels)
Sulfur oxides	2,000
Hydrogen sulfide	15

And the maximum effluent levels presented in Table 2 should be achieved by discharges from common effluent treatment units that should be designed to handle the characteristics and loading of wastewaters generated from the industrial estate. In some cases, different types of treatment units will be needed to handle different types of wastewaters. (For example, chemical precipitation units may be required to handle toxic metallic wastewaters, and biological treatment units for handling organic wastewaters).

Table 21 Effluents from Industrial Estates

Parameter	Maximum value
pH	6-9
BOD	50
COD	250
TSS	50 (20 if toxic metals are present at significant levels)
Oil and grease	10
Cadmium	0.1
Chromium	
Hexavalent	0.1
Total	0.5
Copper	0.5
Lead	0.1
Nickel	0.5
Zinc	2
Phenol	0.5
AOX	1
Benzene	0.05
Benzo(a)pyrene	0.05
Sulfide	1
Temperature increase	≤ 3 C

In case of solid wastes and sludge, where possible, generation of sludge should be minimized and sludge must be treated, and if toxic metals are present, the sludge must be stabilized. And another pollution called noise pollution abatement measures should achieve either the levels given in table 3 or a maximum increase in background levels of 3 decibels (measured on the A scale) [dB (A)]. Measurements are to be taken at noise receptors located outside the project property boundary (table 22).

Table 22 Ambient Noise from Industrial Estate

Maximum allowable log equivalent (hourly measurements), in dB(A) Day Night		
	Day	Night
Receptor	(07:00-22:00)	(22:00-07:00)
Residential, institutional, education	55	45
Industrial, commercial	70	70

Such kinds of emissions guidelines stipulation is good environmental practice for industrial estates and it should be analyzed by other researchers as further studies for Yangon City Industrial Estates in future. Because a significant environmental benefit of industrial estates is the opportunity to take advantage of economies of scale by providing common effluent and waste management facilities for every plants in industrial estate.

So this research will be announced to alert to create sustainable concrete production under guide lines of EMS (ISO 14001) and to evaluate Myanmar Environmental Conservation Law's standards and to complete effective fully loaded industrial estate in future. Other environmental researchers can analyze in this flow for further studies.

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APPENDICES

Appendix A

Sample General Questionnaire and answers in Myanmar language
and official request letter from Chief Engineer Office of Engineering Department
(Building), Yangon City Development Committee for Yangon CBPs

ပြည်ထောင်စုသမ္မတမြန်မာနိုင်ငံတော်
ရန်ကုန်တိုင်းဒေသကြီးအစိုးရ
ရန်ကုန်မြို့တော်စည်ပင်သာယာရေးကော်မတီ
အင်ဂျင်နီယာဌာန(အဆောက်အအုံ)

စာအမှတ်၊ ၉၄၇၀ / ဖဖပ /စည်ပင်ယာ/အုံ(အုပ်)
ရက် စွဲ ၊ ၂၀၁၂ ခုနှစ် အောက်တိုဘာလ ၁၉ ရက်

သို့

စက်ရုံမှူး

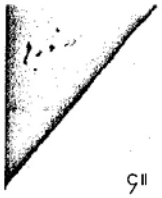
Y.C.D.C မြောက်ဥက္ကလာပစက်ရုံများ + ပုဂ္ဂလိက ကွန်ကရစ်စက်ရုံများ
ရန်ကုန်မြို့၊ ရန်ကုန်တိုင်းဒေသကြီး

အကြောင်းအရာ ။ **မဟာအင်ဂျင်နီယာဘွဲ့ယူ သုတေသနကျမ်းအတွက် အချက်အလက်များ စုဆောင်းကောက်ယူရန်**

၁။ အထက်အကြောင်းအရာပါကိစ္စနှင့်ပတ်သက်၍ အင်ဂျင်နီယာဌာန(အဆောက်အအုံ) မှ အငယ်တန်းအင်ဂျင်နီယာ-၂ ဦးထွန်းခေါင်ဝင်း (ကပ-၃၅၉၀၅) သည် ထိုင်းနိုင်ငံ၊ ဘန်ကောက်မြို့၊ ကဆက်ဆတ်တက္ကသိုလ်တွင် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ မဟာအင်ဂျင်နီယာဘွဲ့ တက်ရောက်သင်ကြားရန် ပြည်ထောင်စုအစိုးရအဖွဲ့ရုံး၏ သဘောတူညီချက်အရ ပညာတော်သင်စေလွှတ်ထားသော ဝန်ထမ်းဖြစ်ပါသည်။

၂။ အဆိုပါ မဟာအင်ဂျင်နီယာဘွဲ့ ကျမ်းပြုကျောင်းသားအနေဖြင့် ရန်ကုန်မြို့တော်ရှိ ကွန်ကရစ်ဖျော်စက်ရုံများအတွက် သဘာဝပတ်ဝန်းကျင်ဆိုင်ရာ စီမံခန့်ခွဲမှုစနစ် ENVIRONMENTAL MANAGEMENT SYSTEM EMS (ISO 14001) FOR CONCRETE BATCHING PLANTS IN YANGON CITY, MYANMAR ကျမ်းအမည်ဖြင့် သုတေသနဆောင်ရွက်လျက်ရှိပါသည်။

၃။ ကျမ်း၏ရည်ရွယ်ချက်မှာ တနေ့တခြားများပြားလာသော မြို့ပြတည်ဆောက်မှုအတွက် ထုတ်လုပ်နေသောကွန်ကရစ်ထုတ်လုပ်မှုကြောင့် သဘာဝပတ်ဝန်းကျင်နှင့် ဂေဟစနစ် ပျက်စီးမှုမရှိစေရေး သုတေသနပြု၍ စနစ်တစ်ခုချမှတ်နိုင်ရန်၊ နိုင်ငံတကာစံသတ်မှတ်ချက်ဖြစ်သော ISO 14001 အား အသုံးချနိုင်ရန်၊ လက်တလောထွက်ရှိအတည်ပြုထားသော Myanmar Environmental Conservation Law အား အထောက်အကူပြုနိုင်ရန်၊ စွန့်ပစ်ပစ္စည်းလျော့ချမှု အစီအမံ Waste Minimization Policy WMP ဆောင်ရွက်နိုင်ရန် ရည်ရွယ်ပါသည်။



၂

၄။ သို့ဖြစ်ပါ၍ ရန်ကုန်မြို့တော်စည်ပင်သာယာရေး နယ်နိမိတ်အတွင်းရှိ ကွန်ကရစ်စက်ရုံများအနေဖြင့် မြို့တော်၏ သဘာဝပတ်ဝန်းကျင်အတွက် ဆောင်ရွက်နေသော ယင်းသုတေသနအတွက် လိုအပ်သည်များ ကူညီဆောင်ရွက်ပေးနိုင်ပါရန် အကြောင်းကြားပါသည်။

ဒွာနမှူး

မိတ္တူကို

ဒွာနမှူး၊ အင်ဂျင်နီယာဌာန (လမ်း နှင့် တံတား)

ရုံးအဖွဲ့မှူး၊ ကော်မတီရုံး

ကွန်ကရစ်ထုတ်လုပ်ရေးစက်ရုံများ

ဦးထွဋ်ခေါင်ဝင်း၊ အင်ဂျင်နီယာဌာန - ၂ (မဟာအင်ဂျင်နီယာဘွဲ့ ကျမ်းပြုကျောင်းသား)

မျှော်စာတွဲ

ရုံးလက်ခံ

မြန်မာနိုင်ငံ၊ ရန်ကုန်မြို့တော်အတွင်းရှိကွန်ကရစ်စက်ရုံများအတွက်

ISO 14001 ကိုအခြေခံသော Environmental Management System (EMS) အတွက် မေးခွန်းလွှာ

ယခုမေးခွန်းလွှာသည် မြန်မာနိုင်ငံ၊ ရန်ကုန်မြို့တော်အတွင်းရှိ ကွန်ကရစ်စက်ရုံများအတွက် ISO 14001 ကိုအခြေခံ သော Environmental Management System (EMS) အားသုတေသနပြု ရေးဆွဲနိုင်ရေး အတွက် အရေးကြီးသော အစိတ်အပိုင်း တစ်ရပ် ဖြစ်ပါသဖြင့် ပြည့်စုံစွာ ကူညီဖြေဆိုပေးပါရန် ပန်ကြားအပ်ပါသည်။

ရှင်းလင်းချက်။ ။ စီစဉ်ထားသော အဖြေများတွင် အမှန်လက္ခဏာ (✓) ခြစ်၍ဖြေကြားနိုင်ပါသည်။

အပိုင်း(၁)။ စက်ရုံ၏ အချက်အလက်များ

(၁/၁)။ အထွေထွေ အချက်အလက်များ

၁။ သင့် ကွန်ကရစ်စက်ရုံ အမျိုးအစား

- ☑ ၁။ ဘူဒိုဇာ အသုံးပြု စက်ရုံ (front end loader)
- ☐ ၂။ အပေါ်မှ တိုက်ရိုက် ထည့်သွင်းလည်ပတ်သည့် စက်ရုံ (overhead bin)
- ☑ ၃။ အစိုစနစ် စက်ရုံ (wet type)
- ☐ ၄။ အခြောက်စနစ် စက်ရုံ (dry type)
- ☐ ၅။ အခြားအမျိုးအစား စက်ရုံ .....

၂။ အလုပ်သမားအင်အား

☐ ၁ မှ ၅၀ ယောက် ☑ ၅၁ မှ ၁၀၀ ယောက် ☐ ၁၀၀ ယောက်နှင့် အထက်

၃။ ကွန်ကရစ် ထုတ်လုပ်မှုနှုန်း

- ☐ ၁။ သီအိုရီအရ ထုတ်လုပ်နိုင်မှု ၃၅ < ၆၀ < ၇၅ (တနေ့ထုတ်လုပ်နိုင်မှု meter cube)
- ☑ ၂။ သီအိုရီအရ ထုတ်လုပ်နိုင်မှု ၉၀ < ၁၂၀ < ၁၈၀ (တနေ့ထုတ်လုပ်နိုင်မှု meter cube)
- ☐ ၃။ သီးခြား ထုတ်လုပ်နိုင်မှုရှိက ဖော်ပြပါ.....

၄။ သင့်စက်ရုံတွင် ISO 14001 စနစ်ကျင့်သုံးနေပါသလား။

☐ ၁။ ရှိပါသည်။

ရှိပါက ကျေးဇူးပြု၍ ခုနှစ်များနှင့်တကွ ဖြေပါ

(စတင်အဆိုပြုသောနှစ် .....မှတ်ပုံတင်သောနှစ် .....)

☐ အကယ်၍ အဆိုပြုပြီး ဆက်လက်မဆောင်ရွက် ဖြစ်ပါက ရပ်ဆိုင်းသွားသော နစ်ကို ဖော်ပြပေးပါ.....

☑ ၃။ မရှိပါ

၅။ သင့်စက်ရုံတွင် စွန့်ပစ်ပစ္စည်းများ လျော့ချမှု အစီအမံများ ရှိပါသလား။

☑ ၁။ ရှိပါသည်။ (ရှိပါက ဖော်ပြပါ)
စက်ရုံတွင် ကုမ္ပဏီနည်းပညာသုံး Reclaimer စက်ဖြင့် Zero Emission ဖြစ်အောင် ဆောင်ရွက်နေပါသည်။

☐ ၂။ မရှိပါ။

၆။ သင့်စက်ရုံတွင် လိုက်နာဆောင်ရွက်နေသော ပတ်ဝန်းကျင်ဆိုင်ရာ ဥပဒေများကို ရွေးပါ။

☐ ၁။ နိုင်ငံတော်အဆင့် ဥပဒေ (ဥပမာ။ ။ မကြာမီက ပြဋ္ဌာန်းထားသော မြန်မာ့ ပတ်ဝန်းကျင် ထိန်းသိမ်းရေး ဥပဒေ)

☐ ၂။ ပေါ်လစီ (Polluters Pay Policy PPP)

☑ ၃။ နည်းဥပဒေများ (ဥပမာ။ မြို့တော်စည်ပင်၏ အက်ဥပဒေများ)

☑ ၄။ ညွှန်ကြားချက်များ (ဥပမာ။ မြို့တော်စည်ပင်၏ ထုတ်ပြန်ချက်များ)

☐ ၅။ မရှိပါ

၇။ သင့်စက်ရုံမှ ထွက်ရှိသော ရေဆိုးများကို စွန့်ထုတ်ရန် မြို့တော်စည်ပင်၏ ခွင့်ပြုချက် ရယူထားပါသလား။

☐ ၁။ ရယူထားပါသည် ☑ ၂။ ရယူထားမှု မရှိပါ

၈။ သင့်စက်ရုံမှ ထွက်ရှိသော ညစ်ညမ်းမှုများအတွက် စက်မှုဇုန်အုပ်ချုပ်ရေး အဖွဲ့၏ ခွင့်ပြုချက် ရယူထားပါသလား။

☐ ၁။ ရယူထားပါသည် ☑ ၂။ ရယူထားမှု မရှိပါ

(၁/၂)၊ ကွန်ကရစ် စက်ရုံတည်ဆောက်ထားရှိမှုနေရာ အနေအထား

၉။ လူနေအိမ်ခြေများနှင့် သင့်စက်ရုံကြားတွင် ထားရှိရမည့် ကင်းလွတ်ဇုန် buffer zone သည် အနည်းဆုံး မီတာ ၁၀၀ (ပေ ၃၂၀ ခန့်) ကွာဝေးပါသလား။

☑ ၁။ ကွာဝေးပါသည် ☐ ၂။ ကွာဝေးမှု မရှိပါ

၁၀။ ကင်းလွတ်ဇုန် buffer zone သည် လေကွယ်ရာ အရပ်တွင် ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၁၁။ သင့်စက်ရုံ အဝန်းအဝိုင်းအတွင်းရှိ မြေအောက်ရေ တည်ရှိမှုခြေအနေအား ဖော်ပြပါ။

☐ ၁။ < ၄ မီတာ (သို့) ၁၃ ပေခန့် (တိမ်သော အခြေအနေ)

☐ ၂။ ၄ မီတာ (သို့) ၁၃ ပေခန့် < တန်ဖိုး < ၁၅ မီတာ (သို့) ၄၉ ပေခန့် (အလယ်အလတ် အခြေအနေ)

☑ ၃။ ၁၅ မီတာ (သို့) ၄၉ ပေခန့် < တန်ဖိုး < ၆၀ မီတာ (သို့) ၂၀၀ ပေခန့် (နက်သည့် အခြေအနေ)

၁၂။ သင့်စက်ရုံတည်ရှိမှုကြောင့် ပတ်ဝန်းကျင်တွင် ထိခိုက်မှု တစုံတရာ ရှိပါသလား။

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ

၁၃။ သင့်စက်ရုံကြောင့် ပတ်ဝန်းကျင်တွင် ထိခိုက်မှု နည်းနိုင်သမျှနည်းပါးအောင် ဆောင်ရွက်ထား ပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

အပိုင်း(၂) ညစ်ညမ်းမှုများအတွက် ဆောင်ရွက်ထားရှိမှုများ

(၂/၁)။ လေထုညစ်ညမ်းမှုအတွက်ပြင်ဆင်ဆောင်ရွက်ထားမှုများ

၁၄။ သင့်စက်ရုံ ဝင်းအတွင်း ဖုန်မှုန့်များ နည်းပါးအောင် မြေပြင်အား ကွန်ကရစ်ခင်း ဆောင်ရွက်ထား ပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၁၅။ သင့်စက်ရုံ ဝင်းအတွင်း ဖုန်မှုန့်များအား ထိန်းချုပ်ရန်နှင့် ကျောက်များရေဆေးရန် ရေဖျန်းစနစ်များ တပ်ဆင် ဆောင်ရွက်ထား ပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၁၆။ သင့်စက်ရုံရှိ ကျောက်သယ် ခါးပတ်များ၏ အပေါ်နှင့်ဘေးနစ်ဖက်တွင် အကာများ တပ်ဆင် ဆောင်ရွက်ထားပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၁၇။ သင့်စက်ရုံရှိ ကျောက်သယ် ခါးပတ်များတခုမှ အခြားတစ်ခုသို့ ပြောင်းလဲသော conveyor transfer point များတွင် အလုံပိတ် ဆောင်ရွက်ထားပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၁၈။ သင့်စက်ရုံတွင် ကျောက်များသွန်ချသော free falling transfer point များတွင် အလုံပိတ် ဆောင်ရွက် ထားပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၁၉။ သင့်စက်ရုံတွင် ၅ မီလီမီတာထက်သေးငယ်သောကျောက်များ သိုလှောင်ရာတွင် အလုံပိတ် ဆောင်ရွက် ထားပါသ လား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၂၀။ သင့်စက်ရုံရှိ ကျောက်ပုံများတွင် အပေါ်ဘက်နှင့် အခြားသုံးဘက်တွင် အလုံပိတ် ဆောင်ရွက် ထားပါသလား။

☐ ၁။ ဆောင်ရွက်ထားပါသည် ☑ ၂။ ဆောင်ရွက်မထားပါ

၂၁။ သင့်စက်ရုံရှိ ကျောက်ပုံများအတွင်း ဝင်ထွက်သည့် အပေါက်ဘက်တွင် အလွယ်တကူ ဖွင့်နိုင်ပိတ်နိုင်သော ကန့်လန့်ကာ များ တပ်ဆင်ဆောင်ရွက် ထားပါသလား။

☐ ၁။ ဆောင်ရွက်ထားပါသည် ☑ ၂။ ဆောင်ရွက်မထားပါ

၂၂။ သင့်စက်ရုံရှိ ဘီလပ်မြေ ဂိုဒေါင်များအား လေလုံအောင် အလုံပိတ်ဆောင်ရွက် ထားပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၂၃။ သင့်စက်ရုံတွင် အိတ်သွပ် ဘီလပ်မြေများကို ဂိုဒေါင်တွင် ဖောက်၍ အသုံးပြုနေပါသလား။

☑ ၁။ အသုံးပြုပါသည် ☐ ၂။ အသုံးမပြုပါ များမကြာမီ CBT စနစ်ကိုသာ အသုံးဖြုပါတော့မည်။

၂၄။ သင့်စက်ရုံတွင် ဘီလပ်မြေသယ်ယူသည့် ကားများ Cement Bulk Truck CBT ကို အသုံးပြုနေပါသလား။

☑ ၁။ အသုံးပြုပါသည် ☐ ၂။ အသုံးမပြုပါ CBT များ ဝယ်ယူထား၍ ပြုစုပါသည်။

၂၅။ သင့်စက်ရုံတွင် ဘီလပ်မြေသယ်ယူသည့် ကားများ၏ ဘီးများအား ရေဆေးခြင်း၊ အခြောက်သန့်ရှင်းခြင်းများ ဆောင်ရွက်ပြီးမှ လမ်းပေါ် သို့စေလွှတ်ခြင်း ဆောင်ရွက်ပါသလား။

☑ ၁။ ဆောင်ရွက်ပါသည် ☐ ၂။ မဆောင်ရွက်ပါ

၂၆။ သင့်စက်ရုံတွင် အသုံးပြုသည့် ကားများ၏ အရှိန်နှုန်းကန့်သတ်ချက်အား ထုတ်ပြန်ခြင်း ဆောင်ရွက်ထားပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၂၇။ သင့်စက်ရုံတွင် ဖုန်မှုန့်များကြောင့် လေထုမညစ်ညမ်းစေရန် အနည်းဆုံး ၁၂ ပေ အမြင့်ရှိ အပင်တန်းများ စိုက်ပျိုးပြီး လေကြောင်းထိန်းဖုန်များ ဆောင်ရွက်ထားပါသလား။

☐ ၁။ ဆောင်ရွက်ထားပါသည် ☑ ၂။ ဆောင်ရွက်မထားပါ

၂၈။ သင့်စက်ရုံတွင် ဖုန်မှုန့်များကြောင့် လေထုမညစ်ညမ်းစေရန် နိုင်လွန်ဖျင်စများကာရံပြီး လေကြောင်းထိန်းဇုန်များ ဆောင်ရွက်ထားပါသလား။

☐ ၁။ ဆောင်ရွက်ထားပါသည် ☑ ၂။ ဆောင်ရွက်မထားပါ

၂၉။ သင့်စက်ရုံတွင် ဖုန်မှုန့်များကြောင့် လေထုမညစ်ညမ်းစေရန် ပုံမှန်တံမြက်လှည်းခြင်း၊ အခြောက်သန့်ရှင်းခြင်းများ ဆောင်ရွက်နေပါသလား။

☑ ၁။ ဆောင်ရွက်နေပါသည် ☐ ၂။ ဆောင်ရွက်မနေပါ

၃၀။ သင့်စက်ရုံတွင် ဖုန်မှုန့်များကြောင့် လေထုမညစ်ညမ်းစေရန် ပုံမှန်အားဖြင့် ကားဘီးနှင့် ကြမ်းခင်းများအား ရေဖျန်း၍ သန့်ရှင်းရေး ဆောင်ရွက်နေပါသလား။

☑ ၁။ ဆောင်ရွက်နေပါသည် ☐ ၂။ ဆောင်ရွက်မနေပါ

(၂/၂)၊ ရေထုညစ်ညမ်းမှုအတွက်ပြင်ဆင်ဆောင်ရွက်ထားမှုများ

၃၁။ သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများ၏ pH တန်ဖိုးကိုသိပါသလား။ (မေးခွန်းရှင်းကလည်း ခါတ်ခွဲစမ်းသပ် ပေးပါမည်။)

☐ ၁။ pH < 7 ☑ ၂။ 7 < pH < 12 ☐ ၃။ pH > 12

၃၂။ သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများ၏ TSS (Total Suspended Solids) တန်ဖိုးကိုသိပါသလား။ (မေးခွန်းရှင်းကလည်း ခါတ်ခွဲစမ်းသပ် ပေးပါမည်။)

☐ ၁။ TSS < 100 ☐ ၂။ 100 < TSS < 200 ☑ ၃။ TSS > 200

၃၃။ ပုံမှန်အားဖြင့် သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများအား မြစ်အတွင်းသို့ တိုက်ရိုက် စွန့်ပစ်ခြင်းများ ဆောင်ရွက်ပါသလား။

☐ ၁။ ဆောင်ရွက်ပါသည် ☑ ၂။ မဆောင်ရွက်ပါ

၃၄။ ပုံမှန်အားဖြင့် သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများအား အများပြည်သူသုံး ရေမြောင်းများအတွင်းသို့ တိုက်ရိုက် စွန့်ပစ်ခြင်းများ ဆောင်ရွက် ပါသလား။

☐ ၁။ ဆောင်ရွက်ပါသည် ☑ ၂။ မဆောင်ရွက်ပါ

၃၅။ ပုံမှန်အားဖြင့် သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများအား အနည်စစ်ကန်များဖြင့် အနည်စစ်ခြင်းများ ဆောင်ရွက်ထား ပါသလား။

☑ ၁။ ဆောင်ရွက်ထားပါသည် ☐ ၂။ ဆောင်ရွက်မထားပါ

၃၆။ သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများအား ကာဗွန်ဒိုင်အောက်ဆိုဒ် CO_2 ဖြင့် pH ညှိခြင်းများ ဆောင်ရွက်မှုရှိပါသလား။

☑ ၁။ ဆောင်ရွက်မှုရှိပါသည် ☐ ၂။ ဆောင်ရွက်မှုမရှိပါ

၃၇။ သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများအား ပြန်လည်သန့်စင်၍ recycled process water အဖြစ် နောင်လုပ်ငန်းစဉ်များတွင်အသုံးပြု ပါသလား။

☑ ၁။ အသုံးပြုပါသည် ☐ ၂။ အသုံးမပြုပါ

၃၈။ သင့်စက်ရုံတွင် ကွန်ကရစ်ကားတစ်စီး၏ drum အားဆေးကြောရာတွင် ရေဂါလံ ၂၀၀ ထက်ပိုမို အသုံးပြု ပါသလား။

☐ ၁။ အသုံးပြုပါသည် ☑ ၂။ အသုံးမပြုပါ

၃၉။ သင့်စက်ရုံတွင် ကွန်ကရစ်ကားတစ်စီး၏ drum အားဆေးကြောရာတွင် လုပ်ရိုးလုပ်စဉ် သမားရိုးကျနည်းများသာ အသုံးပြု ပါသလား။ (ခေတ်မီ နည်းစနစ်သုံးပါက ဖော်ပြပါ။ ဥပမာ။ ။ ဓါတုဆေးရည်ဖြင့် ဆေးကြောခြင်း)

☐ ၁။ အသုံးပြုပါသည် ☐ ၂။ အသုံးမပြုပါ

☑ ၃။ ခေတ်မီနည်းစနစ်များ သုံးပါက ဖော်ပြရန် Reclaimer [illegible] Stoning Out [illegible]

၄၀။ သင့်စက်ရုံမှ ထွက်ရှိသောရေဆိုးများ၏ pH နှင့် TSS တန်ဖိုးများအား စောင့်ကြည့်စစ်ဆေးသော စနစ်များရှိ ပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

(၂/၃)၊ ကွန်ကရစ်အကျန်များကြောင်ညစ်ညမ်းမှုများအတွက်ပြင်ဆင်ဆောင်ရွက်ထားမှုများ

၄၁။ သင့်စက်ရုံမှ ထွက်ရှိပိုလျှံသော ကွန်ကရစ်အကျန်များအား မြေဖို့ခြင်းလုပ်ငန်းများတွင် တရားဝင်စွန့်ပစ်ရန် သက်ဆိုင်ရာ အဖွဲ့အစည်းများမှ ခွင့်ပြုမိန့်တစုံတရာ ရှိပါသလား။ [illegible]

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ [illegible]

၄၂။ သင့်စက်ရုံမှ ထွက်ရှိပိုလျှံသော ကွန်ကရစ်အကျန်များအား တရားမဝင်စွန့်ပစ်ခဲ့သဖြင့် အရေးယူခံရမှုများ ရှိပါသလား။ (မှတ်တမ်းတင်ထားပါသလား။)

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ

၄၃။ သင့်စက်ရုံမှ ထွက်ရှိပိုလျှံသော ကွန်ကရစ်အကျန်များအား ပြန်လည်အသုံးပြု၍ နောက်ထပ် ကွန်ကရစ်ထုတ်လုပ်မှုများတွင် ရောနှောအသုံးပြုခြင်းများ ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၄၄။ သင့်စက်ရုံမှ ထွက်ရှိပိုလျှံသော ကွန်ကရစ်အကျန်များအား ပြန်လည်အသုံးပြု၍ လမ်းနှင့်ပလက်ဖောင်း ဆိုင်ရာ ပစ္စည်းများအဖြစ် ပြန်လည်ထုတ်လုပ် အသုံးပြုခြင်းများ ရှိပါသလား။

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ

၄၅။ သင့်စက်ရုံမှ ထွက်ရှိပိုလျှံသော ကွန်ကရစ်အကျန်များအား ပြန်လည်အသုံးပြု၍ အဆောက်အအုံဆိုင်ရာ ဆောက်လုပ်ရေးသုံး ပစ္စည်းများအဖြစ် ပြန်လည်ထုတ်လုပ် အသုံးပြုခြင်းများ ရှိပါသလား။

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ

၄၆။ သင့်စက်ရုံမှ ထွက်ရှိပိုလျှံသော ကွန်ကရစ်အကျန်များအား ၁၀၀% ပြန်လည်အသုံးပြုနိုင်သော ပြန်လည်သန့်စင်စက် reclaimer unit/ recycle unit များတပ်ဆင် အသုံးပြုမှု ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

(၂/၄)၊ ဆူညံသံများ အတွက်ပြင်ဆင်ဆောင်ရွက်ထားမှုများ

၄၇။ သင့်စက်ရုံရှိ မီးစက်များ၊အင်ဂျင်များမှ ထွက်ရှိသော ဆူညံသံများအတွက် အသံထိန်းကိရိယာ များတပ်ဆင် အသုံးပြုမှု ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၄၈။ သင့်စက်ရုံရှိ မော်တော်ယာဉ်များ၏ လေဘရိတ်များ၊ ဟွန်းများအား အသံဆူညံမှုမရှိအောင် ထိန်းချုပ်ထားပါသလား။

☑ ၁။ ထိန်းချုပ်ထားပါသည် ☐ ၂။ ထိန်းချုပ်မထားပါ

၄၉။ သင့်စက်ရုံရှိ ကျောင်သယ်ခါးပတ် များအား အသံဆူညံမှုမရှိအောင် အလုံပိတ်ခြင်း၊ ရော်ဘာတုံးများခံ၍ ထိန်းချုပ်ထားခြင်းများရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၅၀။ သင့်စက်ရုံရှိ မော်တော်ယာဉ်များ၏ အင်ဂျင်များ၊ အိပ်ဇော်ပိုက်များအား အသံဆူညံမှုမရှိအောင် ထိန်းချုပ်ထားပါသလား။

☑ ၁။ ထိန်းချုပ်ထားပါသည် ☐ ၂။ ထိန်းချုပ်မထားပါ

၅၁။ သင့်စက်ရုံမှ ထွက်ရှိသော ဆူညံသံများအားထိန်းချုပ်ရန် လုပ်ကွက်များအနီးသစ်ပင်တန်းများ စိုက်၍အသံထိန်းချုပ်မှုများ ဆောင်ရွက်ထားပါသလား။

☐ ၁။ ဆောင်ရွက်ထားပါသည် ☑ ၂။ ဆောင်ရွက်မထားပါ

အပိုင်း (၃)၊ EMS အတွက် ဝန်ထမ်းများအား လေ့ကျင့်ပေးမှုနှင့် ပညာပေးမှု

၅၂။ သင့်စက်ရုံတွင် သဘာဝပတ်ဝန်းကျင်ထိန်းသိမ်းမှု၊ EMS နှင့်ပတ်သက်သော သင်တန်းပို့ချမှုများ ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

☐ ၃။ ရှိပါသည် ဆိုပါက သင်တန်းအမည်၊ ကျင်းပသောနေ့ရက်၊ ပို့ချသည့် အဖွဲ့အစည်းများ အမည် ကိုရေးပါ

Concrete Quality အတွက် ISO 9001 လျှောက်ထားရာမှ ISO 14001 အတွက် [illegible] ISO 14001 လျှောက်ထားရန် အဖွဲ့တစ်ဖွဲ့ ဖွဲ့ကာ [illegible] ဆောင်ရွက် နေပါသည်

၅၃။ သင့်စက်ရုံမှ ထွက်ရှိသောစွန့်ပစ်ပစ္စည်းများ လျှော့ချမှုအစီအမံ WMP အတွက် သင်တန်းပို့ချမှုများ ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

☐ ၃။ ရှိပါသည် ဆိုပါက သင်တန်းအမည်၊ ကျင်းပသောနေ့ရက်၊ ပို့ချသည့် အဖွဲ့အစည်းများ အမည် ကိုရေးပါ

Reclaimer စက်ကို လာရောက် တပ်ဆင်ပေးသည့် [illegible] SENTAI ကုမ္ပဏီမှ [illegible] အင်ဂျင်နီယာများက WMP နှင့်ပတ်သက်သော short training ပို့ချသွားပါသည်

၅၄။ သင့်စက်ရုံအား သဘာဝပတ်ဝန်းကျင် ထိခိုက်မှုမရှိဘဲ အမြဲလည်ပတ်နိုင်စေရန် စာတမ်းဖတ်ပွဲများကျင်းပမှု (သို့) ဝန်ထမ်းများစေလွှတ် တက်ရောက်စေမှု ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

☐ ၃။ ရှိပါသည် ဆိုပါက သင်တန်းအမည်၊ ကျင်းပသောနေ့ရက်၊ ပို့ချသည့် အဖွဲ့အစည်းများ အမည် ကိုရေးပါ

မြန်မာနိုင်ငံ အင်ဂျင်နီယာအသင်း MES မှကျင်းပသော Sustainable Production နှင့် Environmental ဆိုင်ရာ ဆွေးနွေးပွဲများနှင့် ဆင်မီနာများ တက်ရောက်ခဲ့ပါသည်

၅၅။ သင့်စက်ရုံအား သဘာဝပတ်ဝန်းကျင် ထိခိုက်မှုမရှိဘဲ အမြဲလည်ပတ်နိုင်စေရန် အလုပ်ရုံဆွေးနွေးပွဲများကျင်းပမှု (သို့) ဝန်ထမ်းများစေလွှတ် တက်ရောက်စေမှု ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

☐ ၃။ ရှိပါသည် ဆိုပါက သင်တန်းအမည်၊ ကျင်းပသောနေ့ရက်၊ ပို့ချသည့် အဖွဲ့အစည်းများ အမည် ကိုရေးပါ

စက်မှုဇုန်များအတွက် ပတ်ဝန်းကျင်ထိန်းသိမ်းရေး အာမခံချက် ဆွေးနွေးပွဲသို့ ကုမ္ပဏီ တာဝန်ရှိသူများ တက်ရောက်ခဲ့ပါသည်

၅၆။ သင့်စက်ရုံတွင် အသုံးပြုနေသော အဆိပ်သင့်စေနိုင်သည့် ဓါတုပစ္စည်းများ၊ ကွန်ကရစ်ဖျော်စပ်မှုတွင် ထည့်သွင်းအသုံးပြု သော ဆေးရည် admixture များအတွက် (အထူး)သင်တန်းပို့ချမှုများ ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

☐ ၃။ ရှိပါသည် ဆိုပါက သင်တန်းအမည်၊ ကျင်းပသောနေ့ရက်၊ ပို့ချသည့် အဖွဲ့အစည်းများ အမည် ကိုရေးပါ

Admixture အမိန့်ရထားသော Plastocrete ကုမ္ပဏီမှ ပညာရှင်များက chemical နှင့်ပတ်သက်သော ဘေးကင်းရေး/ ... များကို ၁၀၀၅ ခုနှစ်က စက်ရုံတွင်း ရက်တိုသင်တန်း လာရောက် ပို့ချပေးပါသည်

၅၇။ သင့်စက်ရုံတွင် တာဝန်ထမ်းဆောင်နေသော ဝန်ထမ်းများ၊ အလုပ်သမားများအတွက် လုပ်ငန်းခွင် အန္တရာယ် ကင်းရှင်းရေး သင်တန်းပို့ချမှုများ ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

☐ ၃။ ရှိပါသည် ဆိုပါက သင်တန်းအမည်၊ ကျင်းပသောနေ့ရက်၊ ပို့ချသည့် အဖွဲ့အစည်းများ အမည် ကိုရေးပါ

လုပ်ငန်းခွင် အန္တရာယ်ကင်းရှင်းရေး အတွက် စက်ရုံတွင်း သင်တန်းများအား HR (Human Resources) ဌာနက စနစ်တကျ ဖွင့်လှစ်ပေးပါသည်

အပိုင်း (၄)၊ EMS အတွက် ဝန်ထမ်းများအား လေ့ကျင့်ပေးမှုနှင့် ပညာပေးမှု

(စက်ရုံအား လေ့လာစဉ်နှင့် အင်တာဗျူးတွင်မေးရန်)

၅၈။ သင့်စက်ရုံအား သဘာဝပတ်ဝန်းကျင် ထိခိုက်မှုနှင့် ပတ်သက်ပြီး တိုင်ကြားကန့်ကွက်လာမှုများ ကြုံတွေ့လာပါက မှတ်တမ်းတင် ဖြေရှင်းဆောင်ရွက်ပေးနိုင်ရန် သီးခြားအဖွဲ့ ဖွဲ့စည်းဆောင်ရွက်ထားမှု ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၅၉။ သင့်စက်ရုံအား သဘာဝပတ်ဝန်းကျင် ထိခိုက်မှုနှင့် ပတ်သက်ပြီး တိုင်ကြားကန့်ကွက်လာမှုများ ရှိပါသလား (သို့) ဌာနဆိုင်ရာအဖွဲ့အစည်းများက ဝင်ရောက်စစ်ဆေး အရေးယူမှုများ ရှိပါသလား။

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ

၆၀။ သင့်စက်ရုံတွင် သဘာဝရင်းမြစ်များ ထုတ်ယူသုံးစွဲမှု (ရေချိုသုံးစွဲမှု၊ စက်သုံးဆီသုံးစွဲမှု၊ ကျောက်များထုတ်ယူ သုံးစွဲမှု...စသည်) တို့အတွက် စောင့်ကြည့်ထိန်းသိမ်းမှု စနစ်များ ရှိပါသလား။

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၆၁။ သင့်စက်ရုံတွင် မိမိစက်ရုံအတွက် သီးသန့်ရေးဆွဲထားသော သဘာဝပတ်ဝန်းကျင် ထိန်းသိမ်းမှုဆိုင်ရာ ညွှန်ကြားချက်များ၊ ပြဋ္ဌာန်းချက်များ ရှိပါသလား။

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ [illegible] (ISO 14001 [illegible])

၆၂။ သင့်စက်ရုံကြောင့် သဘာဝပတ်ဝန်းကျင် ထိခိုက်မှုများအား တိုင်းတာတွက်ချက်ရန် စံပြုသတ်မှတ်ထားသော အတိုင်းအတာ စနစ်များရှိပါသလား။ (ဥပမာ။ ။ ယာဉ်နှင့် စက်ယန္တရားများ၏ အသံ ဒက်စီဘယ်မီတာ မည်မျှရှိပါက ဆူညံသံအဖြစ် သတ်မှတ်သည်......စသည်)

☑ ၁။ ရှိပါသည် ☐ ၂။ မရှိပါ

၆၃။ သင့်စက်ရုံကြောင့် မိမိတို့တွင်ပတ်ဝန်းကျင် ထိခိုက်မှုများ ဖြစ်ပွားရပါသည်ဟု အနီးဝန်းကျင်မှ ကန့်ကွက် တိုင်ကြားလာမှုများ ရှိပါသလား။

☐ ၁။ ရှိပါသည် ☑ ၂။ မရှိပါ

၆၄။ သင့်စက်ရုံတွင် ပတ်ဝန်းကျင်ထိခိုက်မှု မရှိစေဘဲရေရှည်တွင် စီးပွားရေးတွက်ခြေကိုက်သော စီမံခန့်ခွဲမှု စနစ်များ ကျင့်သုံးရန် စိတ်ဝင်စားပါသလား (သို့) အစီအစဉ် ရှိပါသလား။

☑ ၁။ စိတ်ဝင်စားပါသည်၊ အစီအစဉ်ရှိပါသည်

☐ ၂။ စိတ်မဝင်စားပါ၊ အစီအစဉ်မရှိပါ

၆၅။ သင့်စက်ရုံမှ ထွက်ရှိသော ညစ်ညမ်းမှုများမှာ ထိန်းချုပ်ရန် လွယ်ကူသည်(သို့) ခက်ခဲသည်၊ ဟု သင်ထင်ပါသလား။

☑ ၁။ ထိန်းချုပ်ရန် လွယ်ကူပါသည်

☐ ၂။ ထိန်းချုပ်ရန် ခက်ခဲပါသည်

☐ ၃။ ကျေးဇူးပြုပြီး သင့် အတွေ့အကြုံကို အခြေခံသော ထင်မြင်ချက်များ ရေးပေးပါ

[illegible] (ဥပမာ။ ။ [illegible] Asphalt Concrete [illegible]) [illegible] AG Truck [illegible] EMS [illegible]

Appendix B

General Questionnaire translate in English

Questionnaire for study Environmental Management System (ISO 14001) for concrete batching plants in Yangon City, Myanmar

This questionnaire is part of thesis for study the efficiency of environmental management system for concrete batching plants in Yangon City, Myanmar so please kindly reply them as detail as below.

Explanation: Please marks ✓on item as your actual operation.

Part 1Initial Data

General data

1. Type of concrete batching plants.

- ☐ 1. Front end loader concrete batching plant
- ☐ 2. Overhead bin concrete batching plant
- ☐ 3. Wet type concrete batching plant
- ☐ 4. Dry type concrete batching plant
- ☐ 5. Others, please identify ……

2. Amount of employees.

☐ 1- 50 people ☐ 51 – 100 people ☐ > 100 people

3. Production rate

- ☐ 1. Productivity in theory 35 < 60 < 75 (cubic meter per day)
- ☐ 2. Productivity in theory 90< 120 < 180 (cubic meter per day)
- ☐ 3. Others, please identify ……

4. Does concrete batching plant has ISO14001 implementation?

- ☐ 1.Yes

  Please identify year.

  (Start year .....and registered .....year)
- ☐ 2. Discontinuous implementation, please identify……..……
- ☐ 3. No

5. Does concrete batching plant has any Waste Minimization Policy WMP?

☐ 1.Yes

Please identify

…….....

.....

☐ 2. No

6. What is the fundamental guideline for pollution control of this concrete batching plant?

☐ 1. Legislation (e.g., Myanmar Environmental Act)

☐ 2. Policy (Polluters Pay Policy PPP)

☐ 3. Regulation (local laws and regulations, YCDC)

☐ 2. Instruction (local municipality's instruction, YCDC)

☐ 3. None

7. Does concrete batching plant has permission of disposal water from YCDC?

☐ 1.Yes ☐ 2. No

8. Does CBP has permission of emissions from industrial zone authority?

☐ 1.Yes ☐ 2. No

Site location of CBP

9. Is buffer zone at least 100m buffer between plant and residential zone?

☐ 1.Yes ☐ 2. No

10. Is bunker located out of the prevailing wind?

☐ 1.Yes ☐ 2. No

11. What is the ground water level of your plant's vicinity?

☐ 1. < 4 m (shallow) ☐ 2. 4m< X <15m (medium)

☐ 1. 15 m< X < 60m (deep)

12. Does CBP detract from local amenity?

☐ 1.Yes ☐ 2. No

13. Does plant access minimize potential impacts on amenity?

☐ 1.Yes ☐ 2. No

POLLUTIONS CONTROL

Air pollution control

14. Does your plant's compound ground pave hard or non-porous surface or concrete paving for dust control?

☐ 1.Yes ☐ 2. No

15. Does your plant have any water spray system for aggregates to wash and dust control?

☐ 1.Yes ☐ 2. No

16. Does your plant enclose belt conveyor on top and two sides?

☐ 1.Yes ☐ 2. No

17. Does your plant enclose all conveyor transfer point?

☐ 1.Yes ☐ 2. No

18. Does your plant enclose all free falling transfer point?

☐ 1.Yes ☐ 2. No

19. Does your plant store aggregates<5 mm in totally enclosed structure?

☐ 1.Yes ☐ 2. No

20. Does your plant enclose aggregate stockpiles on at least the top and 3 sides?

☐ 1.Yes ☐ 2. No

21. Does your plant install a flexible curtain to cover stockpile entrance sides?

☐ 1.Yes ☐ 2. No

22. Does your plant total enclose the ware house (especially for cement)?

☐ 1.Yes ☐ 2. No

23. Are your plant still using cement bag packing system?

☐ 1.Yes ☐ 2. No

24. Does your plant install use Cement Bulk Truck CBT as cement carrier?

☐ 1.Yes ☐ 2. No

25. Does your plant usually wash or dry clean vehicle's wheels before leaving from site?

☐ 1.Yes ☐ 2. No

26. Does your plant post vehicle speed limits in plant's compound?

☐ 1.Yes ☐ 2. No

27. Does your plant use at least 12 feet vegetative buffer for dust prevention?

☐ 1.Yes ☐ 2. No

28. Does your plant use nylon sheet barriers for dust prevention?

☐ 1.Yes ☐ 2. No

29. Does your plant have regular plan to sweep or dry clean up method?

☐ 1.Yes ☐ 2. No

30. Does your plant have regular plan to clean all vehicles and floor with water spray method?

☐ 1.Yes ☐ 2. No

Water pollution control

31. What is the value of pH in your plant's waste water?

☐ 1. pH<7 ☐ 2. 7<pH<12 ☐ 3. pH> 12

32. What is the value of TSS (Total Suspended Solids) in your plant's waste water?

☐ 1. TSS<100 ☐ 2. 100<TSS<200 ☐ 3. TSS> 200

33. Does your plant direct discharge waste water to river normally?

☐ 1.Yes ☐ 2. No

34. Does your plant direct discharge waste water to public drainage system normally?

☐ 1.Yes ☐ 2. No

35. Does your plant construct and use sedimentation trap/pond for waste water?

☐ 1.Yes ☐ 2. No

36. Does your plant use CO_2 dosing process for pH controlling and reducing?

☐ 1.Yes ☐ 2. No

37. Does your plant use recycling process water in production?

☐ 1.Yes ☐ 2. No

38. Does your plant use fresh water> 200 gallons for one truck drum cleaning?

☐ 1.Yes ☐ 2. No

39. Does your plant use traditional washing out system?

☐ 1.Yes ☐ 2. No

40. Does your plant have any monitoring system for pH and suspended solid TSS?

☐ 1.Yes ☐ 2. No

Solid waste pollution control

41. Does your plant have license for landfill from authority organization?

☐ 1.Yes ☐ 2. No

42. Does your plant have any records of punishment for illegally landfill?

☐ 1.Yes ☐ 2. No

43. Does your plant reuse solid wastes in production?

☐ 1.Yes ☐ 2. No

44. Does your plant reproduce solid wastes as road and traffic accessories?

☐ 1.Yes ☐ 2. No

45. Does your plant use solid wastes in construction purpose (grouting, filling, compaction and etc.)?

☐ 1.Yes ☐ 2. No

46. Does your plant install and use reclaimer unit or recycle unit for solid wastes recycling?

☐ 1.Yes ☐ 2. No

Noise pollution control

47. Does your plant use silent type generators for noise control?

☐ 1.Yes ☐ 2. No

48. Does your plant's vehicle reduce noise of air breaks and prohibit using horn in truck?

☐ 1.Yes ☐ 2. No

49. Does your plant enclose conveyor belt and use rubber liner for noise control?

☐ 1.Yes ☐ 2. No

50. Does your plant's vehicles and heavy machinery fit silencing devices in engine and exhaust pipe for noise control?

☐ 1.Yes ☐ 2. No

51. Does your CBP plant trees around working areas for noise control and reduce?

☐ 1.Yes ☐ 2. No

Staff training and education for EMS

52. Does your plant have special training for EMS and Environmental issue?

☐ 1.Yes ☐ 2. No

☐ 3. (If answer is Yes), please write date and name of training

.....

53. Does your plant have any training for Waste Minimization Process WMP?

☐ 1.Yes ☐ 2. No

☐ 3. (If answer is Yes), please write date and name of training

.....

54. Does your plant have arrange or held seminars for sustainable CBP?

☐ 1.Yes ☐ 2. No

☐ 3. (If answer is Yes), please write date and name of training

.....

55. Does your plant have arranged or held workshops for emissions control?

☐ 1.Yes ☐ 2. No

☐ 3. (If answer is Yes), please write date and name of training

.....

56. Does your plant have any special staff training about toxic of admixture?

☐ 1.Yes ☐ 2. No

☐ 3. (If answer is Yes), please write date and name of training

.....

57. Does your plant have any safety precaution training for operators and workers?

☐ 1.Yes ☐ 2. No

☐ 3. (If answer is Yes), please write date and name of training

.....

Staff training and education for EMS (questions in semi-interviews and site visits)

58. Does your plant have any community liaison teams for claimants?

☐ 1.Yes ☐ 2. No

59. Does your plant have any records for complains and official investigations?

☐ 1.Yes ☐ 2. No

60. Does your plant have any monitoring systems on resources usage?

☐ 1.Yes ☐ 2. No

61. Does your plant have any single CBP laws and legislations for Environment?

☐ 1.Yes ☐ 2. No

62. Does your plant have any measuring systems or scales for Environmental impacts?

☐ 1.Yes ☐ 2. No

63. Does your plant receive any complains or public arguments from public about pollutions?

☐ 1.Yes ☐ 2. No

64. Does your plant have any plan or idea to run cost effective management systems?

☐ 1.Yes ☐ 2. No

65. Do you think your plant's pollutions are very difficult to control?

☐ 1.Yes ☐ 2. No

☐ 3. Please describe your point of views.....

.....

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.....

.....

Appendix C

Laboratory results of waste water from Yangon City CBP

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

(WW) A - 0018

WASTEWATER QUALITY TEST RESULTS FORM

Client: ဦးထွန်ခေါင်ဝင်း

Address:

Nature of Water: Wastewater (Outlet)

Location: Chaung Wa

Date and Time of collection: 21.10.2012

Date and Time of arrival at Laboratory: 22.10.2012

Date and Time of Commencing examination: 22.10.2012

Date and Time of Completing: 23.10.2012

Results of Wastewater Analysis

Parameters	Influent Results	Effluent Results
Nitrate (mg/l)		
pH		12.20
Chemical Oxygen Demand (COD) (mg/l)		
Biochemical Oxygen Demand (BOD)(5 days at 20°C)(mg/l)		
Dissolve Oxygen (DO) (mg/l)		
Total Solids (mg/l)		
Suspended Solids (mg/l)		347
Dissolved Solids (mg/l)		
Phosphate (mg/l)		
Ammonia Nitrogen (NH_3)(mg/l)		
Ammonium Nitrogen (NH_4) (mg/l)		

Tested by

Signature:

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature:

Name: Win Myint
~~B.E (Civil) 1980, M.MES~~
Technical Officer
ISO TECH Laboratory

(a division of WEG Limited)

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

(WW) A - 0015

WASTEWATER QUALITY TEST RESULTS FORM

Client: ဦးထွန်ခေါင်ဝင်း

Address:

Nature of Water: Wastewater (Outlet)

Location: South Okala

Date and Time of collection: 22.10.2012

Date and Time of arrival at Laboratory: 22.10.2012

Date and Time of Commencing examination: 22.10.2012

Date and Time of Completing: 23.10.2012

Results of Wastewater Analysis

Parameters	Influent Results	Effluent Results
Nitrate (mg/l)		
pH		11.4
Chemical Oxygen Demand (COD) (mg/l)		
Biochemical Oxygen Demand (BOD)(5 days at 20°C)(mg/l)		
Dissolve Oxygen (DO) (mg/l)		
Total Solids (mg/l)		
Suspended Solids (mg/l)		208
~~Dissolved Solids (mg/l)~~		
~~Phosphate (mg/l)~~		
~~Ammonia Nitrogen (NH_3)(mg/l)~~		
~~Ammonium Nitrogen (NH_4) (mg/l)~~		

Tested by

Signature:

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature:

Name: Win Myint
B.E (Civil) 1980, M.MBS
Technical Officer
ISO TECH Laboratory

(a division of WEG Limited)

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

(WW) A - 0014

WASTEWATER QUALITY TEST RESULTS FORM

Client: ဦးထွန်ခေါင်ဝင်း

Address:

Nature of Water: Wastewater (Outlet)

Location: Hlaing Tha Ya

Date and Time of collection: 21.10.2012

Date and Time of arrival at Laboratory: 22.10.2012

Date and Time of Commencing examination: 22.10.2012

Date and Time of Completing: 23.10.2012

Results of Wastewater Analysis

Parameters	Influent Results	Effluent Results
Nitrate (mg/l)		
pH		11.2
Chemical Oxygen Demand (COD) (mg/l)		
Biochemical Oxygen Demand (BOD)(5 days at 20°C)(mg/l)		
Dissolve Oxygen (DO) (mg/l)		
Total Solids (mg/l)		
Suspended Solids (mg/l)		231
~~Dissolved Solids (mg/l)~~		
~~Phosphate (mg/l)~~		
~~Ammonia Nitrogen (NH_3)(mg/l)~~		
~~Ammonium Nitrogen (NH_4) (mg/l)~~		

Tested by

Signature:

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature:

Name: Win Myint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

(a division of WEG Limited)

ISO TECH LABORATORY

ISO-TECH LABORATORY

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

(18)A - 0435

WATER QUALITY TEST RESULTS FORM

Client: High Tech (T.K.T)

Address:

Nature of Water: ရေလှောင်ကန် (Tank-1)

Location: သာကေတ

Date and Time of collection: 13.9.2012

Date and Time of arrival at Laboratory: 13.9.2012

Date and Time of Commencing examination: 14.9.2012

Results of Water Analysis			WHO Guideline
Temperature		°C	
pH	7.6		6.5 - 8.5
Colour (True)		TCU	15 TCU
Turbidity		NTU	5 NTU
Conductivity		micro S/cm	
Toatal Hardness		mg/l as $CaCO_3$	500 mg/l as$CaCO_3$
Total Alkalinity	132	mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness		mg/l as $CaCO_3$	
Iron		mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)	370	mg/l	250 mg/l
Sodium Chloride (as NaCL)		mg/l	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Sulphate (as SO_4)	86	mg/l	200 mg/l
Total Solids	800	mg/l	1500 mg/l
Suspended Solids	70	mg/l	50 - 200 mg/l
Dissolved Solids		mg/l	1000 mg/l

Tested by

Signature:

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

(a division of WEG Limited)

Approved by

Signature:

Name: Win Myint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

(WW) A - 0017

WASTEWATER QUALITY TEST RESULTS FORM

Client: ဦးထွန်းခါဝင်း

Address:

Nature of Water: Wastewater (Outlet)

Location: Shwe Pyi Thar

Date and Time of collection: 22.10.2012

Date and Time of arrival at Laboratory: 22.10.2012

Date and Time of Commencing examination: 22.10.2012

Date and Time of Completing: 23.10.2012

Results of Wastewater Analysis

Parameters	Influent Results	Effluent Results
Nitrate (mg/l)		
pH		11.60
Chemical Oxygen Demand (COD) (mg/l)		
Biochemical Oxygen Demand (BOD)(5 days at 20°C)(mg/l)		
Dissolve Oxygen (DO) (mg/l)		
Total Solids (mg/l)		
Suspended Solids (mg/l)		276
Dissolved Solids (mg/l)		
Phosphate (mg/l)		
Ammonia Nitrogen (NH_3)(mg/l)		
Ammonium Nitrogen (NH_4) (mg/l)		

Tested by

Signature: Heint

Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

Approved by

Signature:

Name: Win Myint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

(a division of WEG Limited)

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

(W)A - 0298

WATER QUALITY TEST RESULTS FORM

Client: ဦးထွန်ခေါင်

Nature of Water:

Location: HIGH TECH, THARKATA.

Date and Time of collection: 6.11.2012

Date and Time of arrival at Laboratory: 8.11.2012

Date and Time of Commencing examination: 9.11.2012

Date and Time of Completing: 9.11.2012

Results of Water Analysis			WHO Drinking Water Guideline (Geneva - 1993)
Phosphate		mg/l	
pH	12.80		6.5 - 8.5
Colour (True)		TCU	15 TCU
Turbidity		NTU	5 NTU
Conductivity		micro S/cm	
Total Hardness		mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity		mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness		mg/l as $CaCO_3$	
Iron		mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)		mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids	180	mg/l	
Dissolved Solids		mg/l	1000 mg/l
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
Signature: Hein
Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

(a division of WEG Limited)

Approved by
Signature:
Name: Win Myint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

ISO TECH LABORATORY

Laboratory Technical Consultant: U Saw Christopher Maung
B.Sc Engg: (Civil), Dip S.E (Delft) Lecturer of YIT (Retd)
Consultant (Y.C.D.C), LWSE 001.
Former Member (UNICEF, Water quality monitoring & Surveillance Myanmar)

No.18, Lanthit Road,
Nanthargone Quarter,
Insein Township, Yangon.
Fax: 01-644506, Ph: 01-640955,
09-73225175, 09-73242162
E-mail: isotechlaboratory@gmail.com

(W)A - 0299

WATER QUALITY TEST RESULTS FORM

Client: ဦးထွဋ်ခေါင်

Nature of Water:

Location: ACP, THARKATA INDUSTRIAL.

Date and Time of collection: 6.11.2012

Date and Time of arrival at Laboratory: 8.11.2012

Date and Time of Commencing examination: 9.11.2012

Date and Time of Completing: 9.11.2012

Results of Water Analysis

			WHO Drinking Water Guideline (Geneva - 1993)
Phosphate		mg/l	
pH	13.00		6.5 - 8.5
Colour (True)		TCU	15 TCU
Turbidity		NTU	5 NTU
Conductivity		micro S/cm	
Total Hardness		mg/l as $CaCO_3$	500 mg/l as $CaCO_3$
Total Alkalinity		mg/l as $CaCO_3$	
Phenolphthalein Alkalinity		mg/l as $CaCO_3$	
Calcium Hardness		mg/l as $CaCO_3$	
Iron		mg/l	0.3 mg/l
Magnesium Hardness		mg/l as $CaCO_3$	
Manganese		mg/l	0.05 mg/l
Carbonate ($CaCO_3$)		mg/l as $CaCO_3$	
Chloride (as CL)		mg/l	250 mg/l
Sodium chloride (as NaCL)		mg/l	
Bicarbonate (HCO_3)		mg/l as $CaCO_3$	
Sulphate (as SO_4)		mg/l	200 mg/l
Total Solids		mg/l	1500 mg/l
Suspended Solids	986	mg/l	
Dissolved Solids		mg/l	1000 mg/l
Phenolphthalein Acidity		mg/l	
Methyl Orange Acidity		mg/l	
Salinity		ppt	

Tested by
Signature:
Name: Zaw Hein Oo
B.Sc (Chemistry)
Chemist
ISO TECH Laboratory

(a division of WEG Limited)

Approved by
Signature:
Name: Win Maint
B.E (Civil) 1980, M.MES
Technical Officer
ISO TECH Laboratory

CURRICULUM VITAE

NAME : Mr. Htut Khaung Win

BIRTH DATE : February 18, 1978

BIRTH PLACE : Einme Town, Ayeyarwady Division, Myanmar

EDUCATION

:**YEAR**	**INSTITUTE**	**DEGREE/DIPLOMA**
2003	Yangon Technological Univ (Y.T.U)	B.E. (Civil)

POSITION/TITLE : Sub Assistant Engineer (S.A.E)

WORK PLACE : Yangon City Development Committee (Y.C.D.C), Yangon, Myanmar
Engineering Department (Building)

SCHOLARSHIP/AWARDS : TICA Scholarship 2011-2013