Tongsuh Petrochemical Corp., Ltd.

INTERNATIONAL CYANIDE MANAGEMENT INSTITUTE

Cyanide Production Summary Audit Report

For the
International Cyanide Management Code

Tongsuh Petrochemical Corp., Ltd.

14 March 2017

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

Tongsuh Petrochemical Corp., Ltd.

Name of Cyanide Production Facility : Tongsuh Petrochemical Corp., Ltd.
Name of Facility Owner : Tongsuh Petrochemical Corp., Ltd.
Name of Facility Operator : Mr. Jong-Kyeong Chae / Plant Manager of Tongsuh Petrochemical Corp., Ltd.
Name of Responsible Manager : Mr. Young-Ho Kim/ Manager, System Management Team of Tongsuh Petrochemical Corp., Ltd.
Address : 108-70, Sapyeong-ro, Nam-gu
State/Province : Ulsan-city, 44785
Country : South Korea
Telephone : 82-52-259-7792
Fax : 82-52-259-7695
E-Mail : yhkim@tspc.co.kr

Location detail and description of operation:
Tongsuh Petrochemical Corp., Ltd. has plant in Petrochemical Complex in Ulsan an industrial city located in southern part of South Korea. The sodium cyanide plant of Tongsuh Petrochemical Corp., Ltd. was established at August 1985 and expanded in 1988, 1993, 2003 and 2013 year. Since 2013 year the production capacity of solid sodium cyanide is about 70,000 ton per year. The briquette type solid sodium cyanide is produced from sodium hydroxide and hydrogen cyanide. The hydrogen cyanide is produced as by-product from acrylonitrile plant operated within same plant area. The solid sodium cyanide is packaged into box or drum and exported to gold mining located in overseas area.
Tongsuh Petrochemical Corp., Ltd. was initially ICMC certified during March 2008 year and recertified during March 2011 year and March 2014 year. Almost 3 years were elapsed since the last ICMC recertification, so third recertification audit is needed during this time. The recertification audit was performed during November and December 2016. And corrective actions for some minor nonconformity and opportunity for improvement issues were performed properly by Tongsuh Petrochemical Corp., Ltd. and results were checked and confirmed during January 2017 year. There was no accident and incident related to environment, health and safety in Tongsuh Petrochemical Corp., Ltd.'s operations of sodium cyanide production, packaging and dispatch since March 2014 when they ICMC recertified.

Tongsuh Petrochemical Corp., Ltd.

Auditor's Finding

This operation is

X in full compliance
☐ in substantial compliance *(see below) with the International Cyanide Management Code
☐ not in compliance

with the International Cyanide Management Code.

This operation has maintained full compliance with the International Cyanide Management Code throughout the previous three audit cycle.
During this recertification audit, I confirmed that Tongsuh Petrochemical Corp., Ltd. has not experienced any significant cyanide incident or compliance problem during the previous three-year audit cycle.

Audit Company : 3Points Co., Ltd.
Audit Team Leader : Mr. Sang-Ho Ahn
E-mail:triplepoint@naver.com
Date(s) of Audit: 18 November, 22 and 23 December 2016, 10 January 2017

I attest that I meet the criteria for knowledge, experience and conflict of interest for Code Verification Audit Team Leader established by the International Cyanide Management Institute and that the audit team meet the applicable criteria established by the International Cyanide Management Institute for Code Verification Auditors.

I attest that this Summary Audit Report accurately describes the findings of the verification audit. I further attest that the verification audit was conducted in a professional manner in accordance with the International Cyanide Management Code Verification Protocol for Cyanide production Operations and using standard and accepted practices for health, safety and environmental audits.

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

Tongsuh Petrochemical Corp., Ltd.	S.HAhn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

SUMMARY AUDIT REPORT

1. OPERATIONS: Design, construct and operate cyanide production facilities to prevent release of cyanide.

Production Practice1.1:Design and construct cyanide production facilities consistent with sound, accepted engineering practices and quality control/quality assurance procedures.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 1.1
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The sodium cyanide plant of Tongsuh Petrochemical Corp., Ltd. was established at August 1985 and expanded in 1988, 1993, 2003 and 2013 year. During the construction and expansion of plant, quality control and assurance activities were implemented according to plan submitted by construction company. During and after the construction, engineering team and Korea Occupational Safety & Health Agency inspected according to drawing, specification and legal requirements. Inspection results were passed and all relevant records related to quality control, quality assurance and inspection was maintained. Automatic interlock systems were established in risky areas to prevent cyanide release during emergency situation. To prevent the contamination of soil and water, all cyanide process facilities were established on a concrete and secondary containment. And dikes were installed to contain spilled cyanide from tanks, piping draining back to tanks and rain water during storm event. And dual pipeline for some specific areas were installed to prevent cyanide release. To prevent overfilling in reactor and storage tanks, level gauge and alarm system were maintained in DCS system. So if the level of reagent and solution were reach the high level, alarm signal appeared in monitor and inputs were automatically shut down. So all the cyanide plant facilities were constructed safely and comply with the code criteria.

Production Practice 1.2: Develop and implement plans and procedures to operate cyanide production facilities in a manner that prevents accidental releases.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 1.2
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

Tongsuh Petrochemical Corp., Ltd. has established and maintained safe operation procedure to control facility maintenance, employee health, PPE control, pollution control and monitoring related to cyanide process. And also emergency response procedure and cyanide handling manual were established and maintained to control emergency situation such as cyanide exposure and release. Tongsuh Petrochemical Corp., Ltd. has implemented the change control procedure in which the issue, review and evaluation of change were defined. Maintenance team has implemented preventive maintenance activities according to period and method defined in program. Process main parameters such as flow rate, temperature, pressure and level were

monitored and monitoring equipment was calibrated according to defined schedule. Cyanide solution and cyanide contaminated water in secondary containments can't be discharged without authorization. Cyanide contaminated water was treated in waste water treatment facility. Tongsuh Petrochemical Corp., Ltd. has controlled cyanide wastes according to waste control instruction including segregation, maintain and dispatch to waste contractor approved by local government office.
The cyanide products were packed in can or drum according to packaging procedure and International Maritime Organization Dangerous Goods code and maintained in warehouse to prevent exposure of moisture. In the warehouse, ventilation fans were installed to prevent the build-up of hydrogen cyanide gas. The storage warehouse is secured from public access as public can't enter the warehouse without special acceptance.

Production Practice 1.3: Inspect cyanide production facilities to ensure their integrity and prevent accidental releases.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 1.3
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Environment and safety team has conducted routine inspection for out-side area of cyanide process. And production team has conducted routine inspection for process including tanks, valves, reactor, storage areas, secondary containments and waste storage tank areas. Inspection frequency was determined from such criteria as importance and failure history etc. as defined in facility check and maintenance procedure. Inspection date, inspector and deficiency were recorded and maintained in computer system. Corrective actions for deficiency were implemented and results were recorded.

2. WORKER SAFETY: Protect workers' health and safety from exposure to cyanide.

Production Practice 2.1: Develop and implement procedures to protect plant personnel from exposure to cyanide.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 2.1
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
According to PPE control procedure and safety operation procedure, employee of Tongsuh Petrochemical Corp., Ltd., visitor and contractor were prevented from exposure of cyanide during routine and non-routine operation and emergency situation. Tongsuh Petrochemical Corp., Ltd. has reviewed proposed process and operational change for their impact on employee health and safety. Employee of Tongsuh Petrochemical Corp., Ltd. have participated safety committee to develop and evaluate health and safety procedures. Tongsuh Petrochemical Corp., Ltd. has used monitoring device calibrated by maintenance team to detect the leakage of hydrogen cyanide.

Tongsuh Petrochemical Corp., Ltd. S.H.Ahn 14 March 2017

Name of Facility | Signature of Lead Auditor | Date

The hydrogen cyanide detectors installed in process and portable detectors were calibrated periodically by maintenance team and the calibration records have been retained at least five years.
Working environment was inspected twice per year for such item as the concentration of hydrogen cyanide, dust and noise. Inspection results for the concentration of hydrogen cyanide were non-detected for 2016 year and comply with ICMC criteria and legal requirement. Tongsuh Petrochemical Corp., Ltd. has identified areas and activities where worker can be exposed to cyanide and maintained warning signs of cyanide presence. Tongsuh Petrochemical Corp., Ltd. has established and implemented the clothing change process in entrance control procedure for employees, contractors and visitors to areas that have a potential for cyanide contamination. Employee, visitor and contractors were required to wear PPE and prohibited smoking, eating and drinking in those potential cyanide contamination areas such as process and packaging areas. Tongsuh Petrochemical Corp., Ltd. has maintained buddy system in repairing, inspection, patrol and maintenance works. During those works, employee use wireless telephone to request assistant for the case of emergency situation. Employee received medical check every year. According to the medical check results, fitness of employee to perform their tasks were determined and follow up actions were implemented.

Production Practice 2.2: Develop and implement plans and procedures for rapid and effective response to cyanide exposure.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 2.2
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Emergency response method and detail response items to cyanide exposures were defined in emergency response procedure and cyanide handling manual. First aid equipment such as low pressure eye washing station, air shower and fire extinguisher were maintained in process and packaging areas. First aid kits such as water, salt solution, oxygen, resuscitator and antidote were in cabinets installed in process area and office. Environment and safety team have inspected the first aid equipment and kits by monthly basis, replaced the equipment and kits not effective anymore and maintained inspection records according to safety operation procedure. To control the cyanide exposure situation, Tongsuh Petrochemical Corp., Ltd. has maintained internal and external communication channel and communication equipment such as wireless phone and phone. Tongsuh Petrochemmical Corp., Ltd. has installed infirmary in plant and can use ambulance operated by Petrochemical Complex Control Agency. Tongsuh Petrochemical Corp., Ltd. has identified three local hospitals in Ulsan city and informed about potential need to treat patients exposed to cyanide. The local hospitals have understood the situation and nominated staff ready for emergency situation. Emergency response plan for cyanide exposure was tested and results were reflected to revised plan. Tongsuh Petrochemical Corp., Ltd. has maintained incident evaluation procedure in which detail investigation, root cause analysis, corrective and preventive actions were defined. Tongsuh Petrochemical Corp., Ltd. has maintained in process and control room area the MSDS, first aid procedure and cyanide handling manual written in Korean. The cyanide storage tanks, containers and pipe line containing cyanide were identified by marking and notice board. And cyanide flow directions were identified by arrow mark in pipe line. Decontamination details for employee, contractor and visitor leaving cyanide process were defined in cyanide handling manual. According to the manual, they have exchanged clothing and passed the air shower before leaving the process.

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

3. MONITORING: Ensure that process controls are protective of the environment.

Production Practice 3.1: Conduct environmental monitoring to confirm that planned or unplanned releases of cyanide do not result in adverse impacts.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 3.1
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

The waste water from cyanide process was initially treated in waste water treatment facility of Tongsuh Petrochemical Corp., Ltd. Sent to sewage water treatment facility operated by Petrochemical Complex Control Agency, finally treated and discharged to sea. Monitoring results of discharged water show the maximum cyanide concentration was 0.27 mg/l WAD comply Korean legal requirement and ICMC criteria. And cyanide concentration at the sea mixing zone was much lower than 0.022mg/l and it was in conformance with legal requirements.
Tongsuh Petrochemical Corp., Ltd. does not indirect discharge to surface water. Because all cyanide process were covered by dike. Spilled cyanide, chemical and rain water were collected and dispatched to waste water treatment facility. The capacity of secondary tank is enough to collect initial rain water poured into cyanide process area. Rain water outside the cyanide process was discharged to rain water line unlikely to be happened the contamination.
Tongsuh Petrochemical Corp., Ltd. has inspected cyanide contamination of soil according to soil environment control instruction. The result of inspection for 2016 year was non-detected. There is no regulation related to the quality of underground water. In case of intended use for underground water is decides as for drinking, agricultural or industrial purpose, specific regulation according to the intended purpose can be applied. Tongsuh Petrochemical Corp., Ltd. has not used underground water in any case, so specific regulation has not been applied until now.
Tongsuh Petrochemical Corp., Ltd. has limited the hydrogen cyanide gas emissions maximum 5ppm according to Korean legal requirement to protect the health of employee and local community. Monitoring results of hydrogen cyanide concentration are non-detected to 0.001ppm complying with legal requirements. Monitoring frequency for air emission of hydrogen cyanide and water discharge were defined in atmosphere and water environment control instruction. With the analysis of monitoring result, Tongsuh Petrochemical Corp., Ltd. can identify and implement the process change, incident and required corrective action.

4. TRAINING: Train workers and emergency response personnel to manage cyanide in a safe and environmentally protective manner.

Production Practice 4.1: Train employees to operate the plant in a manner that minimizes the potential for cyanide exposures and releases.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 4.1
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

According to training procedure, Tongsuh Petrochemical Corp., Ltd. has trained 2 hours every month for existing employee and 16 hours special training for new employee related to cyanide hazards. Tongsuh Petrochemical Corp., Ltd. has prepared and implemented annual training plan in which such items as wearing of personnel protective equipment, emergency response plan for cyanide release and responsibility, authority and detail control method for dealing cyanide were included. The annual training plan was implemented and training records were maintained. Usually plant safety controllers qualified according to procedure have implemented training for workers in cyanide process area. And also cyanide production team leader qualified as safety trainer have conducted daily training before the start of daily works and monthly training. Tongsuh Petrochemical Corp., Ltd. has evaluated the training effectiveness by written test. And also team leader has conducted daily observation for workers to check the implementation of safety policy and procedures.

Production Practice 4.2: Train employees to respond to cyanide exposures and releases.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 4.2
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Tongsuh Petrochemical Corp., Ltd. has trained workers for emergency response procedure and cyanide handling manual including cyanide release and employee exposure cases. Detail items in the procedure and manual as following procedure, control of exposure and release were included in the training. They have conducted drills of detail emergency response plan for cyanide release and exposure. The results of drills for emergency response plan were evaluated and analyzed. For some deficiency and gap, the relevant procedures were revised and trained to relevant personnel. The results of education and training were recorded.

5. EMERGENCY RESPONSE: Protect communities and the environment through the development of emergency response strategies and capabilities.

Production Practice 5.1: Prepare detailed emergency response plans for potential cyanide releases.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 5.1
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Tongsuh Petrochemical Corp., Ltd. has developed and maintained emergency response plan for the response of cyanide release and exposure. In that plan, potential release and results from that release were defined. And Tongsuh Petrochemical Corp., Ltd. has prepared and maintained the emergency response procedure and cyanide handling manual in which such detail items as emergency communication, rescue, use of first aid kit, evacuation and pollution prevention action were defined.

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

Production Practice 5.2: Involve site personnel and stakeholders in the planning process.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 5.2
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
The emergency response plan deals with not only those plant workers assigned to their respective duties but also those concerned with the company. Tongsuh Petrochemical Corp., Ltd. has prepared and established emergency communication channels to contact nearby plants at the chemical complex and potentially affected communities. Communities such as local government, Korea Occupational Safety & Health Agency, fire agency, police and hospitals are included. And they have communicated information of the risks related to the cyanide production, release and exposure. Tongsuh Petrochemical Corp., Ltd. has engaged in regular consultation and communication with relevant stakeholders.

Production Practice 5.3: Designate appropriate personnel and commit necessary equipment and resources for emergency response.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 5.3
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
All employees have been tasked with their respective duties to be performed during an emergency situation. Tongsuh Petrochemical Corp., Ltd. has nominated environment and safety team leader as primary emergency response coordinator, team manager as alternative emergency response coordinator and plant manager as total controller. Tongsuh Petrochemical Corp., Ltd. has maintained emergency response procedure in which training items such as personnel rescue, use of first aid kit, lead excavation, control of facility etc. were defined and trained to emergency response team reader and members. And also call-out procedure and 24-hour contact information for emergency response team lead leader, members and relevant responders were defined in the emergency response procedure.
In emergency response plan, team members were divided into several parts as communication part, personnel rescue part, excavation leading part and response part etc. And duties and responsibilities were defined.
And also environment and safety team have tested the call-out response and evaluated the response results. The equipment for emergency response actions is maintained in a ready state through regular check and repair. A list of such equipment is also maintained. Tongsuh Petrochemical Corp., Ltd. has informed the cyanide related emergency response plan, risk and hazards to outside entities included in the emergency response plan. And during the emergency mock drill, some outside entities such as fire agency and nearby companies also participated.
After the mock emergency drills, evaluation and review of effectiveness for emergency response plans were implemented.

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

Production Practice 5.4: Develop procedures for internal and external emergency notification and reporting.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 5.4
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Tongsuh Petrochemical Corp., Ltd. has prepared and maintained emergency response plan in which communication with relevant internal management, regulatory agency and external response provider such as Ulsan fire agency, Ulsan police station, Korea Occupational Safety & Health Agency and hospitals such as Ulsan hospital and Jungang hospital. Tongsuh Petrochemical Corp., Ltd. has identified such affected communities as nearby plants, companies and Ulsan local communities and also they have informed the cyanide related risk, control of emergency and excavation. The nearby companies and plants, Ulsan local communities as the Ulsan city hall for citizen, fire agency and hospitals and media as Ulsan broadcasting station were included in communication channel of emergency response plan.

Production Practice 5.5: Incorporate into response plans and remediation measures monitoring elements that account for the additional hazards of using cyanide treatment chemicals.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 5.5
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Tongsuh Petrochemical Corp., Ltd. has prepared and maintained emergency response plan in which remedial processes and prohibit the use of concentrated chemicals as sodium hypochlorite, ferrous sulfate and hydrogen peroxide to released cyanide in surface water were defined. The detail method for remediation, neutralization, decontamination, control of contaminated material and products were clearly defined in cyanide handling manual. The emergency response plan clearly addressed the potential need for environmental monitoring to identify the extent and effects of hydrogen cyanide and sodium cyanide release and include sampling method, parameter and possible location. Tongsuh Petrochemical Corp., Ltd. has not experienced the actual emergency case until now from the start of plant operation.

Production Practice 5.6: Periodically evaluate response procedures and capabilities and revise them as needed.

The operation is
X in full compliance with
☐ in substantial compliance with Production Practice 5.6
☐ not in compliance with

Summarize the basis for this Finding/Deficiencies Identified:
Tongsuh Petrochemical Corp., Ltd. has conducted the emergency mock drill periodically.

Tongsuh Petrochemical Corp., Ltd.	S.H Ahn	14 March 2017
Name of Facility	Signature of Lead Auditor	Date

Tongsuh Petrochemical Corp., Ltd.

The adequacy of emergency response plan was checked and evaluated during the mock drill and results were recorded. According to emergency response instruction, emergency plan shall be evaluated it's appropriateness after the actual emergency cases and also revised as needed. Actual emergency requiring the plan has not been occurred since the start of plant operation.