TWYFORD (GHANA) CERAMICS COMPANY LIMITED

Preliminary Environmental Report

Submitted to: Environmental Protection Agency of Ghana

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Reviewed by: GREEN DEVELOPMENT SOLUTIONS, GHANA

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ACRONYMS

AER	Annual Environmental Reports
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Study
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
HDPE	High Density Polyethylene
HIV/AIDS	Human immunodeficiency virus /Acquired immune deficiency syndrome
HSE	Health, Safety and Environment
ILO	International Labour Organisation
LDC	Less Developed Country
MDA's	Ministries, Departments and Agencies
MSDS	Material Safety Data Sheet
MT	Metric tonne
OSH	Occupational Safety and Health
PEA	Preliminary Environmental Assessment
PEMP	Provisional Environmental Management Plan
PER	Preliminary Environmental Report
POC	potentially oil-contaminated
PPE	Personal Protective Equipment
Ppm	Parts per million
QHSE	Quality, Health, Safety and Environment
STMA	Sekondi Takoradi Metropolitan Area
TCC	Thermo-mechanical Cuttings Cleaner
TPH	Total Petroleum Hydrocarbon
TOR	Terms of Reference
VOC	Volatile Organic Compounds

EXECUTIVE SUMMARY

Twyford (Ghana) Ceramics Company Limited is registered in Ghana under the company's code of 1963 (Act 179), **Twyford (Ghana) Ceramics Company Limited** intends to operate a long–term onshore facility for the efficient and environmentally sound ways of production of ceramic tiles at Aboadze a suburb of **Shama** in the Shama District of the Western Region.

The project proposed by **Twyford (Ghana) Ceramics Company Limited** and described herein, involves applying new technology to produce ceramic tiles for the local and international Market. It is envisage produced 100,000 square meters per day.

Purpose of the PEA

The Environmental Protection Agency Act, 1994 (Act 490) and the Environmental Assessment Regulations, 1999 (LI 1652) of Ghana make it an offence to commence or operate a project of this nature without an Environmental Permit. Activities under Section 23 (Construction) require that industrial construction other than residential building be registered and environmental permit obtained.

Section 9 (1) of the LI indicates; "Where the Agency upon consideration of the application decides that there is the need for a Preliminary Environmental Assessment (PEA) to be submitted in respect of the application, the Agency shall request the applicant to submit a Preliminary Environmental Report (PER) on the proposed undertaking".

In pursuance of this Section, the EPA requested a Preliminary Environmental Report after consideration of the application (*Form EA1, Site Plan & Facility Layout Plan*) submitted **Twyford (Ghana) Ceramics Company Limited**.

The Preliminary Environmental Report (PER) is intended to identify potential adverse environmental, health and social impacts. The PER also identifies mitigation measures which will be implemented to prevent or minimize potential adverse impacts while enhancing the project's beneficial impacts and promoting more sustainable processes.

Stakeholders Identified/Consulted

As part of the Preliminary Environmental Assessment process, relevant stakeholders to the identification and prediction of potential environmental and social impacts likely to result from the operation of our activities and identify mitigation measures to address these impacts.

The major stakeholders consulted in the process include:

- ✓ Shama District Assembly
- ✓ Volta River Authority
- ✓ Ghana Port and Harbour Authority
- ✓ EPA – Western Region
- ✓ Town and Country Planning – Sekondi
- ✓ Electricity Company of Ghana
- ✓ Ghana Water Company Limited – Sekondi

- ✓ Ghana National Fire Service – Takoradi
- ✓ Ghana National Gas Company
- ✓ Department of Urban Roads and
- ✓ Vodafone Ghana – Takoradi

Policy, Legal and Instrumental Frameworks

The relevant policy, legal and administrative frameworks for the extractive industry include:

- ✓ Environmental Protection Agency Act, 1994 (Act 490)
- ✓ Ghana Environmental Impact Assessment Procedures (1995)
- ✓ Environmental Assessment Regulation, 1999 (LI 1652)
- ✓ Fees and Charges (Amendment) Instrument, 2015 (LI 2228)
- ✓ Occupational Safety and Health Policy for Ghana (Draft 2004)
- ✓ National Environmental Sanitation Policy of Ghana (1999)
- ✓ National Workplace HIV/AIDS Policy
- ✓ Labour Act, 2003 (Act 651).
- ✓ Ghana Ports and Harbour Authority Law 1986, PNDC Law 160
- ✓ Ghana Investment Promotion Centre Act 1994, Act 478
- ✓ Port Regulation, 1964, LI 352
- ✓ Factory, Office and Shop Act 1970, Act 328
- ✓ Fire Precaution (Premises) Regulation, 2003 (LI 1724)

- ✓ Sekondi Takoradi Metropolitan Assembly and
- ✓ Workman's Compensation Law 1987

Project Description

The main activities to be carryout during the project have been categorized into two phases, construction and operational phases.

Constructional Phase activities will involve

- Clear of land
- Construction of access road and fence wall
- Construction of Raw Material Warehouse
- Construction of Laboratory
- Construction of finish product warehouse
- Installation of unit operation equipments:

The operational phase activities involve the following:

- Producing ceramic tiles.
- Management of environmental pollution

The factory will be installed within an area approximately 78.61 acres located within the Aboadze industrial enclave at Aboadze. The area had already been demarcated for light industrial activities.

Description of Project Environment

The project is located at Aboadze in the Shama District of the Western Region of Ghana. The District is bounded on the East by Central Region, West by Sekondi Takoradi Metropolitan Assembly, Mpohor Wassa East District on the North and Gulf of Guinea on the South.

Relief and Drainage

The relief falls under the coastal lowlands relief region of the country. The general topography is low lying and undulating with lowland area having an altitude of up to 6m below sea level and hilly area rising to 30m above sea level.

Climate

The District falls within the coastal savannah zone of Ghana. The main rainy seasons are from May to mid-July with the wettest month being June and second minor season from August to October. The mean annual rainfall ranges between 171cm and 185cm. The district has relatively mild temperature, averaging around 22^{o}c.

Vegetation and Landuse

The proposed site is located in an undeveloped area demarcated for light industrial activities. It current houses a lot of tropical grass with scattering shrubs.

Air Quality

Air quality of the area is influenced by the location of the site, which is surrounded by developed fishing activities. The average air quality value for the area is 254 µg/m^3.

Water Quality and Use

The proposed site is served by the Aboadze water distribution system. Surface water runoff at the site is currently across the vegetated and undulating land.

Assessment of Potential Impacts

The assessment process evaluated the potential impacts and other issues and concerns that could arise from the operation of the facility. Stakeholder involvement played a major role in the identification and analysis of the potential impact of the proposed project. The presentation of the potential impact is in two broad groups – the beneficial and adverse impacts.

- ✓ **The main beneficial impacts of the project are:**
  - Technology transfer and acquisition of new skill by local people
  - Employment opportunities and
  - Improved District and rural economy through capital injection
- ✓ **The potential adverse impacts include the following:**
  - Potential impact on air quality
  - Potential impact on water quality and use.
  - Potential noise generation

- Potential infection rate increase in HIV/AIDS cases
- Potential fire and explosion risk
- Occupational Health and Safety concerns
- Waste Generation and Disposal and
- Vehicular traffic concern

Mitigation of Potential Impacts

The Preliminary Environmental Report considered a number of mitigation and enhancement measures for implementation to ensure the project becomes socially acceptable, environmentally sound and sustainable. These measures are:

- ✓ Noise level reduction;
- ✓ Fire and explosion prevention;
- ✓ Occupational health and safety;
- ✓ Water quality maintenance;
- ✓ Waste management;
- ✓ Air quality control; and
- ✓ Vehicular traffic control measures.

Environmental Monitoring

Environmental monitoring is undertaken to ensure adequate follow up on general project environmental commitment and performance during

implementation of the project. Monitoring will be carried out throughout the implementation of the project and will focus on the following:

- ✓ Fire and explosion risk monitoring;
- ✓ Waste generation and disposal; and
- ✓ Occupational health and safety.

Provisional Environmental Management Plan

The Provisional Environmental Management Plan (PEMP) presents significant environmental issues identified in the PER in a practical form for action or implementation during project installation and initial operation. The PEMP defines steps that will be followed to ensure that environmental obligations and stewardship responsibilities are discharge.

The validity period for a PEMP is eighteen months from the commencement of the project in accordance with section 24(1) of the LI 1652, 1999. The PEMP will be converted into a sustainable Environmental Management Plan (EMP) within the eighteen – month period and submitted to the EPA for approval.

The provisional EMP covers the following:

- ✓ Water resource management;
- ✓ Fire and explosion risk management;
- ✓ Water quality protection;
- ✓ Noise control measures;

- ✓ Occupational health and safety management ; and
- ✓ Waste generation and disposal.

The relevant scope of the PEMP for the project would include the following

- ✓ Measures proposed to mitigate environmental impact;
- ✓ Monitoring plans;
- ✓ Emergency response plan;
- ✓ Schedules for implementation of specific action (including mitigation and monitoring);
- ✓ Training and capacity building needs;
- ✓ Roles and responsibilities for various actions;
- ✓ Documentation and reporting requirement; and
- ✓ Financial requirement for implementation of plans.

In order to ensure effective implementation of the plan the company will employ the following professional staff:

- Health, Safety ,Environmental and Security Manager; and
- Facility Operations Manager (Site Manager).

The PEMP assigns responsibilities to the above professional staff in relation to the environmental commitment of **Twyford (Ghana) Ceramics Company Limited.** The plan also makes provision for adequate capacity building for key

personnel in order to ensure that all environmental commitments are fully realized.

1.0 Introduction

Twyford (Ghana) Ceramics Company Limited is registered in Ghana under the company's code of 1963 (Act 179), **Twyford (Ghana) Ceramics Company Limited** intends to operate a long–term facility for the efficient and environmentally sound ways of producing ceramic products.

The project proposed by **Twyford (Ghana) Ceramics Company Limited** and described herein, involves applying new technology to produced ceramic tiles.

1.1 Purpose of the PEA

The Environmental Protection Agency Act, 1994 (Act 490) and the Environmental Assessment Regulations, 1999 (LI 1652) of Ghana make it an offence to commence or operate a project of this nature without an Environmental Permit. Activities under Section 23 of the LI (Construction) require that industrial construction other than building be registered and environmental permit obtained.

Section 9 (1) of the LI indicates; "Where the Agency upon consideration of the application decides that there is the need for a Preliminary Environmental Assessment (PEA) to be submitted in respect of the application, the Agency shall request the applicant to submit a Preliminary Environmental Report (PER) on the proposed undertaking". In pursuance of this Section, the EPA requested a PER after consideration of the application submitted by **Twyford**

(Ghana) Ceramics Company Limited .The PER is intended to identify potential adverse environmental, health and social impacts. The PER also identifies mitigation measures which will be implemented to prevent or minimize potential adverse impacts while enhancing the project's beneficial impacts and promoting more sustainable processes.

1.2 Stakeholders Identified/Consulted

As part of the PEA process, relevant stakeholders were consulted by **Twyford (Ghana) Ceramics Company Limited** to involve them in the identification and prediction of potential environmental and social impacts likely to result from the operation of the proposed activities and to help identify mitigation measures to address these impacts.

The major stakeholders consulted in the process include:

1. Volta River Authority
2. Shama District Assembly
3. EPA – Western Region
4. Electricity Company of Ghana
5. Ghana Water Company – Sekondi
6. Ghana National Fire Service – Takoradi and
7. Vodafone Ghana – Takoradi and
8. Ghana Port and Harbour Authority

9. Department of Urban Roads

10. Ghana National Gas Company

1.3 Policy, Legal and Institutional Frameworks

The relevant policy, legal and administrative frameworks for the manufacturing of ceramic tiles include:

1. Environmental Protection Agency Act, 1994 (Act 490)

2. Ghana Environmental Impact Assessment Procedures (1995)

3. Environmental Assessment Regulations, 1999 (LI 1652)

4. Fees and Charges (Amendment) Instrument 2015 (LI 2228)

5. Occupational Safety and Health Policy for Ghana (Draft 2004)

6. National Environmental Sanitation Policy of Ghana (1999)

7. National Workplace HIV/AIDS Policy, and

8. Labour Act, 2003 (Act 651)

9. Ghana Ports and Harbour Authority Law 1986, PNDC Law 160

10. Ghana Investment Promotion Centre Act 1994, Act 478

11. Port Regulation, 1964, LI 352

12. Factory, Office and Shop Act 1970, Act 328

13. Ghana Maritime Authority Act 2002, Act 630 and

14. Ghana Shipping Act 2002, Act 645

1.3.1 Environmental Protection Agency Act

The Environmental Protection Agency (EPA) Act, 1994 (ACT 490) grants the Agency enforcement and standard setting powers to ensure compliance with such standards and guidelines. The EPA is also mandated to ensure compliance with the Ghana EA requirement and procedures for proposed as well as existing "undertaking". Additionally, the Agency is required to:

1. Control and prevent the discharge of waste; and the generation, treatment, storage, transportation and disposal of waste; and
2. Control and monitor use and advice on regulations and management of hazardous substances.

The Agency is also vested with the power to:

1. Determine what constitutes an "*adverse effect on the environment*" or an activity posing "*a serious threat to the environment or public health*";
2. Require Environmental Impact Assessments (EIA's), Environmental Management Plans (EMP's), Annual Environmental Reports (AER's), etc. of an "*undertaking*"; and
3. Regulate and serve an Enforcement Notice for any offending or non-complying undertaking.

Furthermore, a requirement by EPA for an Environmental Assessment (EA) for an undertaking overrides any authorizing Ministries, Departments and Agencies (MDA's) from licensing, permitting, approving or consenting to such undertaking, unless notified otherwise by the EPA.

1.3.2 Ghana EIA Procedures and Environmental Assessment Regulations

The Ghana EIA procedures published in 1995 were converted into EA Regulation (L.I 1652) in 1999. The Environmental Assessment (EA) Regulations combine both an environmental assessment and environmental management systems. The regulation prohibits commencing an "*undertaking*" (including construction other than building, fabrication metal products, etc), without prior registration and environmental permit.

Undertaking/activities are grouped into schedules to enable registration and securing environmental permit from the EPA through the EA system. The schedules include undertaking requiring registration and environmental permit (Schedule 1), EA is a mandatory undertaking (Schedule 2), as well as schedule 5 relevant undertaking where an activity is located in or near Environmental Sensitivity Area in Ghana.

The EA Regulations define the relevant stages in the procedure, including:

1. Registration
2. Screening
3. Preliminary Environmental Assessment (PEA);

4. Scoping and Terms of Reference (TOR)

5. Environmental Impact Assessment (EIA)

6. Public Notices and Public Hearing

7. Review of EA reports, Environmental permitting and certification

8. Environmental Management Plan (EMP), and

9. Annual Environmental Report (AER)

The AER is required to be submitted to the EPA on and for all undertakings which are granted an Environmental Permit, twelve (12) months from commencement of operation, and annually thereafter. An annual report would provide evidence of the extent of compliance with relevant mitigation commitments, monitoring requirements and results.

An EMP on the other hand provides information on the system for meeting the environment stewardship commitment (including mitigation and monitoring, training, reporting and resource allocation and responsibilities) for a project. EMP's are developed for projects subject to PEA's and EIA's, and are required to be submitted to the EPA within eighteen (18) months of commencement of operations, and updated every (3) years thereafter.

1.3.3 Environmental Assessment Regulations (Amendment) 2015, LI 2228

The Environmental Assessment Regulations (Amendment) 2015 (LI 2228) stipulates the fees and charges to be paid by proponents with respect to Environmental Permits and Certificates.

1.3.4 Occupational Safety and Health Policy for Ghana

The policy statement of the Occupational Safety and Health (OSH) Policy (draft 2004) is:

"*To prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing, as far as reasonably practicable, the cause of hazards in the working environment and, therefore, the risk to which employees and public may be exposed*".

The policy is derived from the provisions of the International Labour Organisation (ILO) convention 155 and 161. The key objective is to ensure the safety, health and welfare of person(s) at work as well as other persons not at work, but who may be affected by the activities of person(s) at work, by preventing or minimizing the cause of hazards through tripartite collaboration and cooperation. The policy document has a specific section on objectives, scope, strategies, activities and promotion and awareness creation.

Ghana has ratified a number of ILO conventions on OSH. Ghana is therefore obliged to give effect to the provisions contained in the convention. In order to meet this national obligation and the functional focus of the Ministry of

Employment and Social Welfare, this draft policy was developed. The policy also supports, and is intended to give effect to, the provisions under section 24(1) of the constitution, which states:

"*Every person has the right to work under safe and healthy conditions*…."

The present law which comes close to addressing OSH concerns is the *Factories, Office and Shops Act* of 1970 (Act 328). However, this law does not recognize the significant spill-over effects of stress generated in the working environment.

1.3.5 Labour Act

The purpose of the Labour Act, 2003 (Act 651) is to amend and consolidate existing laws relating to labour, employees, employers, trade union and industrial relations as well as to establish a National Labour Commission.

The Act provides for, among others: (i) the rights and duties of employers and workers; (ii) the definition of what is legal or illegal strike; (iii) guarantees trade unions and freedom of associations, and (iv) establishes the Labour Commission to mediate and act in respect of all labour issues.

Under Part XV (Occupational, Health, Safety and Environment), it explicitly indicates that it is the duty of an employer to ensure that every worker employed by him or her works under satisfactory, safe and healthy conditions.

1.3.6 National Workplace HIV/AID Policy

The HIV and AIDS epidemic is a national problem, and discrimination of workers and people living with AIDS is creating unwarranted personal hardships, stigmatization and significant cost to society. The broad objectives of the policy are to:

1. Provide protection from discrimination in the workplace to people living with HIV and AIDS;
2. Prevent HIV and AID spread amongst workers; and
3. Provide care, support and counselling for those infected and affected.

Guiding principles of the National Workplace HIV/AIDS Policy include the following:

1. HIV and AIDS screening should not be require from job applicants or person in employment. Thus, Standard Medical Fitness Forms should not request HIV status of employee or prospective employee;
2. Person with HIV - illness should be allowed to work for as long as medically fit and person impaired by HIV – illness should be provided with reasonable alternative working arrangement and /or assignments;
3. All workers with HIV- illness are entitle to affordable healthcare services; and

4. Industry should promote dissemination of information on HIV and AIDS in the workplace and the necessary precautions which should be taken to reduce risk of transmission among workers.

1.3.7 Factories, Office and Shop Act

The *Factories, Office and Shop Act* of 1970 (Act 328) mandates the Factory Inspectorate Department to register factories and ensure that internationally accepted standards of providing safety, health and welfare of person are adhered to all premises covered by the Act. It defines a factory to include any premises (whether in or not in a building) in which one or more persons are employed in manual labour in any process.

1.3.8 Ghana Ports and Harbour Authority Law 1986, PNDC Law 160

The Ghana Port and Harbour Authority Law 1986, PNDC Law 160 mandates the Ghana Ports and Harbour Authority (GPHA) to plan, build, develop, manage, maintain, operate and control Ports in Ghana. The law enjoins the GPHA among other function to:

- Provide in the port facilities as appear to it to be necessary for the efficient and proper operation of the port
- Maintain the port facilities and extend and enlarge any such facilities as it shall deem fit
- Regulate the use of any port and of the port facilities and
- Maintain and deepen as necessary the approaches to, and the navigable water within and outside the limits of any port, and

also maintain lighthouse and beacons and other navigational services and as appear to it to be necessary.

The law further stipulates that the GPHA could, in addition to the above functions and subject to the provisions of the law, carry on such activities as it deem necessary for the discharge of its functions. These include to:

- ✓ Carry on the business of pilotage
- ✓ Supervise stevedoring, lighterage and container service, where these are provided by persons other than the authority
- ✓ Operate tugs, dredgers and other craft for towering, salvage, fir-prevention and protection of life
- ✓ Supply water to shipping and generate and supply electricity
- ✓ Appoint, license and regulate stevedores, master porters to operate in the container terminals and
- ✓ Establish pilotage district, direct that pilotage shall be compulsory in any such districts, license pilots for work in such districts and establish pilotage boards and specify their duties including the duty of inquiring into the conduct of pilots.

1.3.9 Ghana Investment Promotion Centre Act 1994, Act 478

The Ghana Investment Promotion Centre Act 1994 (Act 478) requires that every investor wishing to invest in the country must in its appraisal of proposed investment projects or enterprises,'…have regards to any effect the

enterprise is likely to have on the environment and measures proposed for the prevention and control of any harmful effects to the environment..'.

1.3.10 Ghana Maritime Authority Act 2002, Act 630

The Ghana Maritime Authority Act 2002, Act 630 has been enacted establishing the Ghana Maritime Authority which will advise Government on maritime matter and assist the Ministry of Harbours and Railway (MOHR) to formulate policies, monitor, regulate and coordinate activities and programmes of the various sub-sectors in the maritime industry.

1.3.11 Ghana Shipping Act 2003, Act 645

The Ghana Shipping Act 2003, Act 645 has been enacted to replace the erstwhile Merchant Shipping Act 1963, Act 183. These are all geared towards the overall restructuring of maritime administration in the country and implement the provision enshrined in the Port Regulation 1964, LI 352.

2.0 PROJECT DESCRIPTION

Twyford (Ghana) Ceramics Company Limited is proposing to set up a ceramic tile manufacturing company on 78.61 acre of land at Aboadze in the Shama District Assembly of the Western Region.

2.1 Project Location

The proposed project is to be sited at Aboadze a suburb of Shama. The site is at an existing residential area, however, Twyford (Ghana) Ceramics Company Limited applied to the Shama District Assembly for change of Landuse to industrial. Change had been granted by the Shama District Assembly to industrial area (See Appendix 1 for confirmation letter**.** Currently, all adjacent land use is undeveloped.

2.3 Project Justification

The sales of ceramic products in the Ghana, particularly in Western Region is being managed by the local pretty traders regardless of environmental hazards its poses.

The proposed project by **Twyford (Ghana) Ceramics Company Limited** involves environmental friendly solutions to produce and sell ceramic tiles in Ghana, particular Western Region and oversee. Operation of the ceramic tile factory will significantly reduce or eliminate environmental pollution associated with the industry in Ghana through recycling of solid waste and broking ceramic tiles.

2.4 Project Components

This project is comprised of the following main components:

The main activities of the project have been categorized into two phases, construction and operational phases.

Constructional Phase activities will involve

- ✓ Clear of land
- ✓ Construction of access road and fence wall
- ✓ Construction of Raw Material Warehouse
- ✓ Construction of Laboratory
- ✓ Construction of finish product warehouse
- ✓ Installation of unit operation equipments :

2.5 Construction and Operation of Ceramic tile factory

The factory will be constructed within an approximately 78.61 acres of land located at the Aboadze within the industrial enclave in the Shama District.

Construction will involve the following:

- ❖ Construction of fence wall
- ❖ Construction of road
- ❖ Construction of offices, workshop, factory floor, warehouse, car parking, laboratory and
- ❖ Installation of the equipments;

Operation will involve the following activities

- ❖ Importation of Raw materials. The raw material to be utilized includes the following underlisted in table 1.

Table 1: Raw Material List

Material Type	Acquiring Plan	Quality and Quantity
Feldspar	Local supply	Good and adequate
Silica sand	Local supply	Good and adequate
Limestone	Local supply	Good and adequate
Kaolin	Local supply	Good and adequate
Black soil	Local supply	Good and adequate
Mountain flour	Local supply	Good and adequate
Hypothermal sand	Local supply	Good and adequate
Porcelain clay	Local supply	Good and adequate
Talc	Local supply	Good and adequate

2.6 Process Description

The ceramic tile manufacturing process consists of a series of successive stages, which can be summarised as follows:

- ✓ Raw materials preparation
- ✓ Pressing and drying of the green body §
- ✓ Firing, with or without glazing §
- ✓ Additional treatments

- ✓ Sorting and packing Depending on whether the product to be made is glazed or not, and whether single fire, twice fire or third fire is involved, the tile will or will not be glazed in a given process, or the order of the glazing and firing stages will be suitably rearranged.

Figure 1 below describe the units operations involved in ceramic tile production

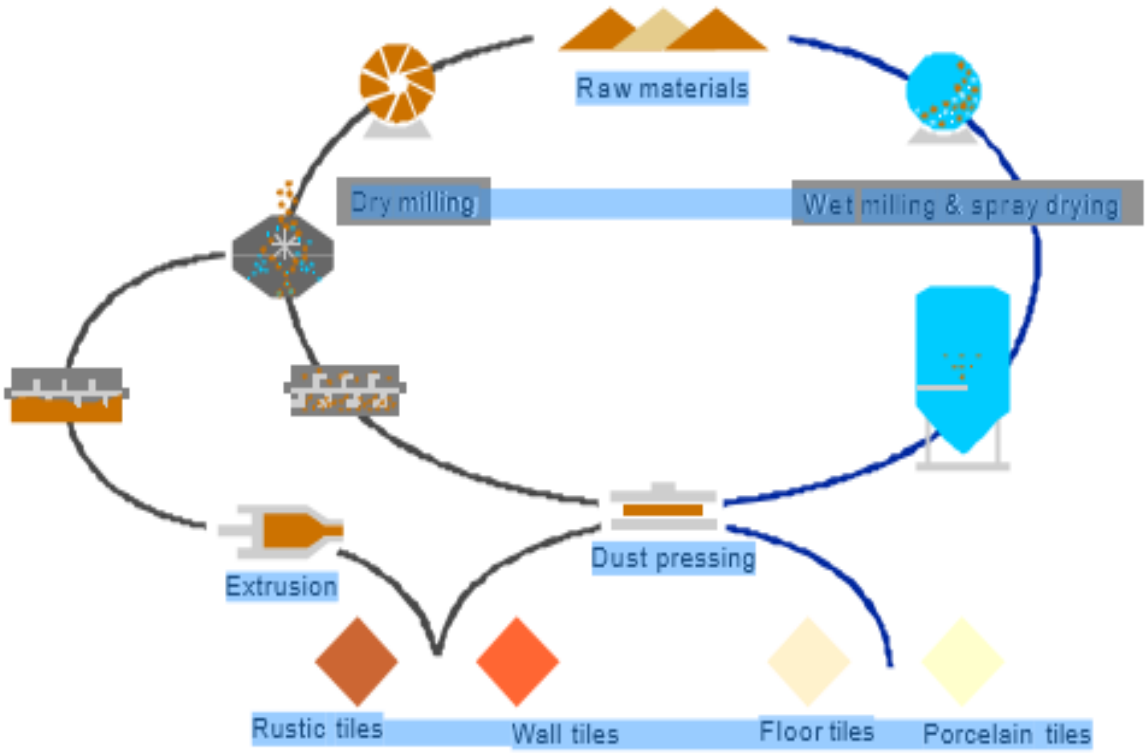


Figure 1: Production of Ceramic tiles

- **Raw materials preparation**

The ceramic process starts by selecting the raw materials required for the body composition, which are mainly clays, feldspars, sands, carbonates and kaolins. In the traditional ceramic industry, the raw materials are generally used as-mined or after some minor treatment. As natural raw materials are

involved, preliminary homogenisation is required in most cases to ensure consistent characteristics.

- **Dry or wet milling**

After a first mixing of the body components, the mixture is usually dry milled (hammer or pendulum mills) or wet milled (continuous or batch ball mills). The resulting milled material exhibits different characteristics depending on whether dry or wet milling is used. In dry milling, fragmentation occurs and particle aggregates and agglomerates remain, with a larger particle size (there are particles larger than 300 microns) than by the wet method (all particles are smaller than 200 microns). A decisive factor in selecting the type of milling to be used is the capital outlay required in each case.

- **Wet milling and spray drying**

Wet milling and subsequent spray drying are currently the most widely implemented methods in ceramic floor and wall tile manufacture by the single-fire process, owing to the important technical improvements they provide. In wet milling, the raw materials can be wholly or partially fed into the ball mills, which are normally the case, or they can be directly dispersed. Part of the water contained in the resulting suspension (slip) is removed by spray drying to obtain a product with the required moisture for each process stage. Spray drying is the most widely implemented drying method in tile manufacture. In this drying process, the fine drops of sprayed suspension come into contact with hot air to yield a solid with low water content. The

moisture content of the body slip usually ranges from 0.0-0.45 kg water/kg dry solid. The spray-drying process reduces the water content to 0.05-0.07 kg water/kg dry solid. Spray drying takes place according to:

1. Pumping and spraying the slip
2. Hot gas generation and feed
3. Drying by contact of hot gas-slip drops and
4. Separation of spray dried powder from the gases.

The spray drying processes is depicted in figure 2 below:

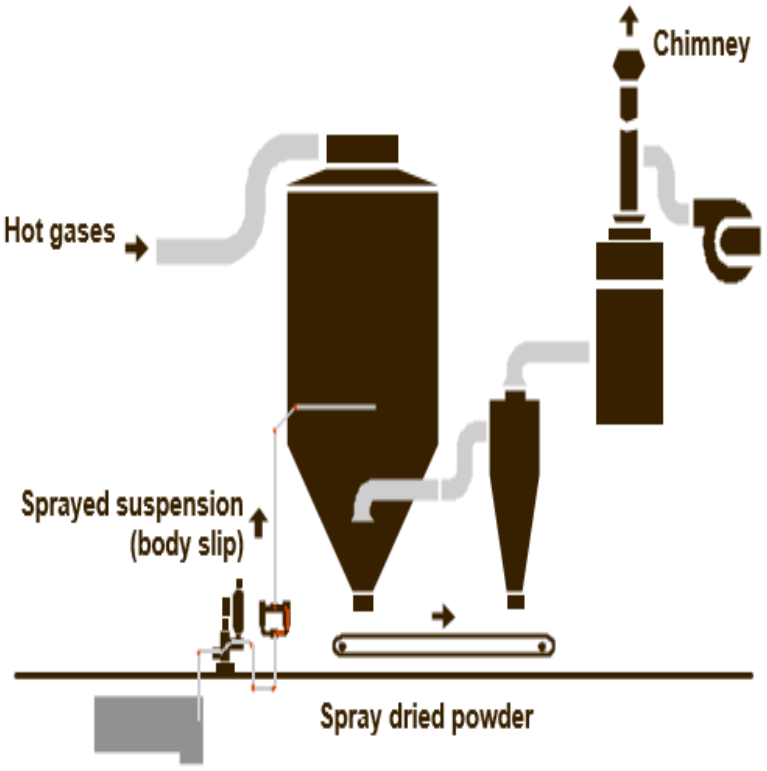


Figure 2: Schematic illustration of the spray-drying process

The spray-drying operation is as follows. The slip from the milling facility storage tanks, with a 60-70 % solids content and appropriate viscosity (around

1000cp.), is fed into the spray dryer by reciprocating pumps. The slip is sprayed as a fine mist, which dries on coming into contact with the hot gas stream. The gases come from a conventional air-natural gas burner or are exhaust gases from a cogeneration turbine. The granulate, with a moisture content of between 5,5 and 7%, is discharged onto a conveyor belt and conveyed to the silos for subsequent pressing. The stream of gases used to dry the slip and produce the powder is exhausted through the top of the spray dryer. The gases have high water content and very fine suspended dust particles. The use of the spray-drying process to obtain the raw material for the body (spray-dried powder) provides important advantages that favour the development of subsequent manufacturing process stages. One of the most important advantages is producing highly uniform, more or less spherical hollow granules that provide the spray-dried powder with high flowability and facilitate press die filling and the pressing of large-size tiles. Another advantage worth mentioning is that it allows performing two operations, namely drying and granulation, simultaneously with same facilities. On the other hand, control of process variables is very simple, although the considerable rigidity of the operating boundary conditions imposed by the facility's geometry and constructive characteristic, need to be taken into account. Further to be noted is the continuous character of the process, which allows process automation. The energy costs of the drying process are quite high, but energy efficiency can be raised by heat recovery from the gases and electricity generation by installing cogeneration turbines.

- **Mixing**

In this body preparation stage, the water and raw materials making up the body composition are closely mixed to a consistent paste that is readily mouldable by extrusion.

- **Dry Pressing**

Dry pressing (at 5 -7% moisture content) with hydraulic presses is the most common tile forming method. Forming takes place by mechanically compressing the paste in the die and is one of the most cost-efficient forming methods for making ceramic ware with a regular geometry. In pressing, the oil-hydraulic press system drives the rams into the powder bed in the die. The main hydraulic press characteristics are as follows: high compaction force, high productivity, easy adjustment and consistency in holding the set pressing cycle schedule. The pressing facilities have developed significantly in the last few years with very sophisticated, easily adjustable and highly versatile programmers.

Extrusion Tile forming by extrusion processes basically consists of putting the plastic body through a die that produces a constant tile cross section. The equipment involved is made up of three main parts: a driving system, the die and the cutter. The most common driving system is an auger.

- **Drying of the green ceramic bodies**

After forming, the tile body is dried to reduce the moisture content (0.2-0.5 %) to appropriately low levels for the firing and eventual glazing stages. In the

dryers that are commonly used in the ceramic industry, heat is transferred mainly by convection from hot gases to the tile surface, and also slightly by radiation from these gases and from the dryer walls to the tile surface. Therefore, during the drying of ceramic bodies, a simultaneous and consecutive displacement of the water takes place through the wet solid and the gas. The air used must be sufficiently dry and hot, because it not only serves to remove the water from the solid but also to provide energy in the form of heat to evaporate the water. At present, the bodies are dried in vertical or horizontal dryers. After shaping, the bodies are placed in the dryer where they face a hot gas counter-current. The hot gases come from an air–natural gas burner or from the kiln cooling stack. The main heat transfer mechanism between the air and the bodies is convection. In the vertical dryers, the pieces are fed into baskets consisting of several decks of rollers. The groups of baskets move upward through the dryer, where they come into contact with the hot gases. The temperature in this type of dryer is normally less than 200°C and the drying cycles range from 35-50 minutes. The horizontal dryers are designed like the rollers kilns. The items are fed onto different decks inside the dryer, and conveyed horizontally on the rollers. Burners located on the sides of the kiln produce the hot drying air counter-current. The maximum temperature in these types of facilities is usually higher than in the vertical dryers (around 350°C) and the drying cycles are shorter, between 15 and 25 minutes. Overall, horizontal dryers have a lower energy consumption compared to the vertical dryers due to a better arrangement

of the items inside the dryer and a lower thermal mass. The resulting emission from the drying stage is a gaseous stream with a temperature of about 110°C, with a very low concentration of suspended particulates from the tile surfaces being drawn along in the exhaust stream.

- **Firing, with or without glazing**

Unglazed products are fired after the drying stage. Similarly, in the case of glazed twice-fire products, the green bodies are fired after drying.

- **Glazing**

Glazing involves applying one or more coats of glaze with a total thickness of 75-500 microns onto the tile proper surface by different methods. Glazing is done to provide the fired product with a series of technical and esthetical properties such as impermeability, cleanability, gloss, colour, surface texture, and chemical and mechanical resistance. The nature of the resulting glaze coating is essentially vitreous, although in many cases the glaze structure contains crystalline elements.

- **Glazes and frits**

The glaze, just like the ceramic body, is made up of a series of inorganic raw materials. The major glaze component is silica (glass former), as well as other elements that act as fluxes (alkalis, alkaline earths, boron, zinc, etc.), opacifiers (zirconium, titanium, etc.), and as colouring agents (iron, chromium, cobalt, manganese, etc.). A wide variety of glazes are formulated depending on the type of product, firing temperature, and the desired

effects and properties of the finished product. In other ceramic processes (porcelain artware, sanitary ware), glazes are formulated that only contain crystalline, natural or synthetic raw materials, which contribute the necessary oxides. However, in ceramic floor and wall tile manufacture, raw materials of a glassy nature (frits) are used. These are prepared from the same crystalline materials that have previously undergone heat treatment at high temperature.

- **Glazes: Preparation and application**.

Decoration In the glaze preparation process, the frit and additives are usually ground in alumina ball mills until a preset reject is obtained. The conditions of the aqueous suspension are then adjusted. Suspension characteristics will depend on the application method to be used. Ceramic tile glazing is done continuously. The most common application methods used in tile manufacture are by waterfall glazing, spraying, dry glazing or decorating. Screen-printing is the most widespread tile decorating technique, due to the ease of this application in the glazing lines. The technique is used in single, twice and third firing and it consists of printing a given design by means of one or more printing screens (tensioned fabric with a set mesh aperture). The screen surface is masked, and the printing ink is only put through the openings of the design to be reproduced. When the squeegee crosses the screen it presses the printing ink through the openings left in the screen, thus printing the design on the tile.

- **Firing**

Firing is one of the most important tile manufacturing process stages as most tile characteristics depend on it. These include mechanical strength, dimensional stability, chemical resistance, cleanability, fire resistance, etc. The main variables to be considered in the firing stage are the thermal cycle (temperature-time, Figure 3) and kiln atmosphere, which must be adapted to each composition and manufacturing technology, according to the ceramic product to be made.

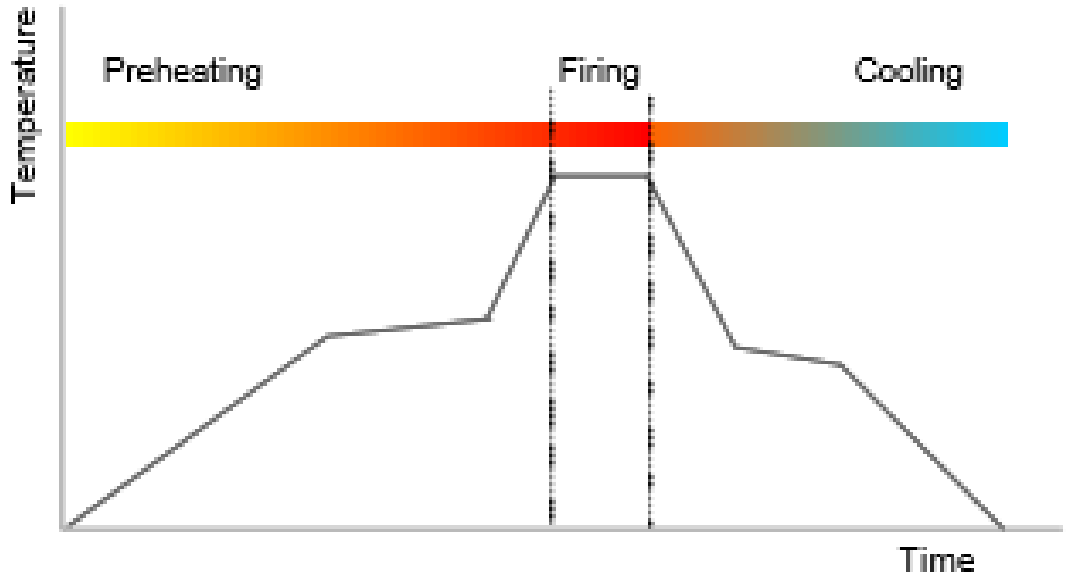


Figure 3: Firing Cycle

In the firing operation, the tiles are subjected to a thermal cycle during which a series of reactions take place in the piece, generating changes in the microstructure and providing the desired final properties.

- **Single and twice fire**

Ceramic materials can undergo one, two or more firings. The unglazed ceramic tiles are fired once; glazed tiles can be fired once after applying the glaze to the green tile (single-firing process), or the body may be fired first, followed by glaze application and subsequent second firing (twice fire process). There may sometimes be an additional drying stage after glazing. This occurs just before the material is placed in the kiln to reduce tile water moisture content to low enough levels for the firing stage to be carried out properly.

- **Fast firing**

This is currently the prevailing ceramic tile firing method and is done in single-deck roller kilns. It has contributed to reducing firing schedules to less than 40 minutes, due to the heightened coefficients of heat transmission to the tiles, as well as their uniformity and flexibility. In the single-deck roller kilns, the tiles travel over rollers and the heat required for firing is provided by natural gas–air burners fitted at the sides of the kiln. The main heat transmission mechanisms are convection and radiation. Figure 4 depicts the processes.

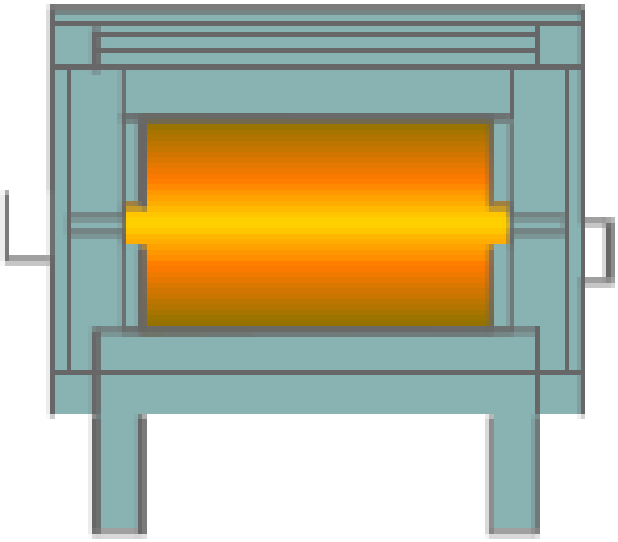


Figure 4: Single deck roller kiln

As non-muffled kilns are involved, gas comes into direct contact with the tiles. This heightens the heat transmission coefficients, reduces the firing cycle and energy consumption and increases kiln flexibility compared to the kilns that were formerly used. The hot gases that arise in firing are released into the air by two emission sources. On the one hand there are the gases from the preheating and firing zone, which are exhausted via a stack at the kiln entrance and the gases from the cooling zone, which are exhausted via a stack at the kiln exit. The gases from the preheating and firing processes are mainly composed of substances from combustion and pollutant gaseous components from raw materials decomposition and suspended dust particles. The gases from the cooling stage consist of hot air and can contain dust particulates.

- **Sorting and packing**

The ceramic tile manufacturing process ends with sorting and packing. Sorting is done by automatic systems with mechanical equipment and tile surface inspection. The result is a controlled product with regard to dimensional regularity, surface appearance and mechanical and chemical characteristics.

Below in figure 5 is an environmental based process diagram.

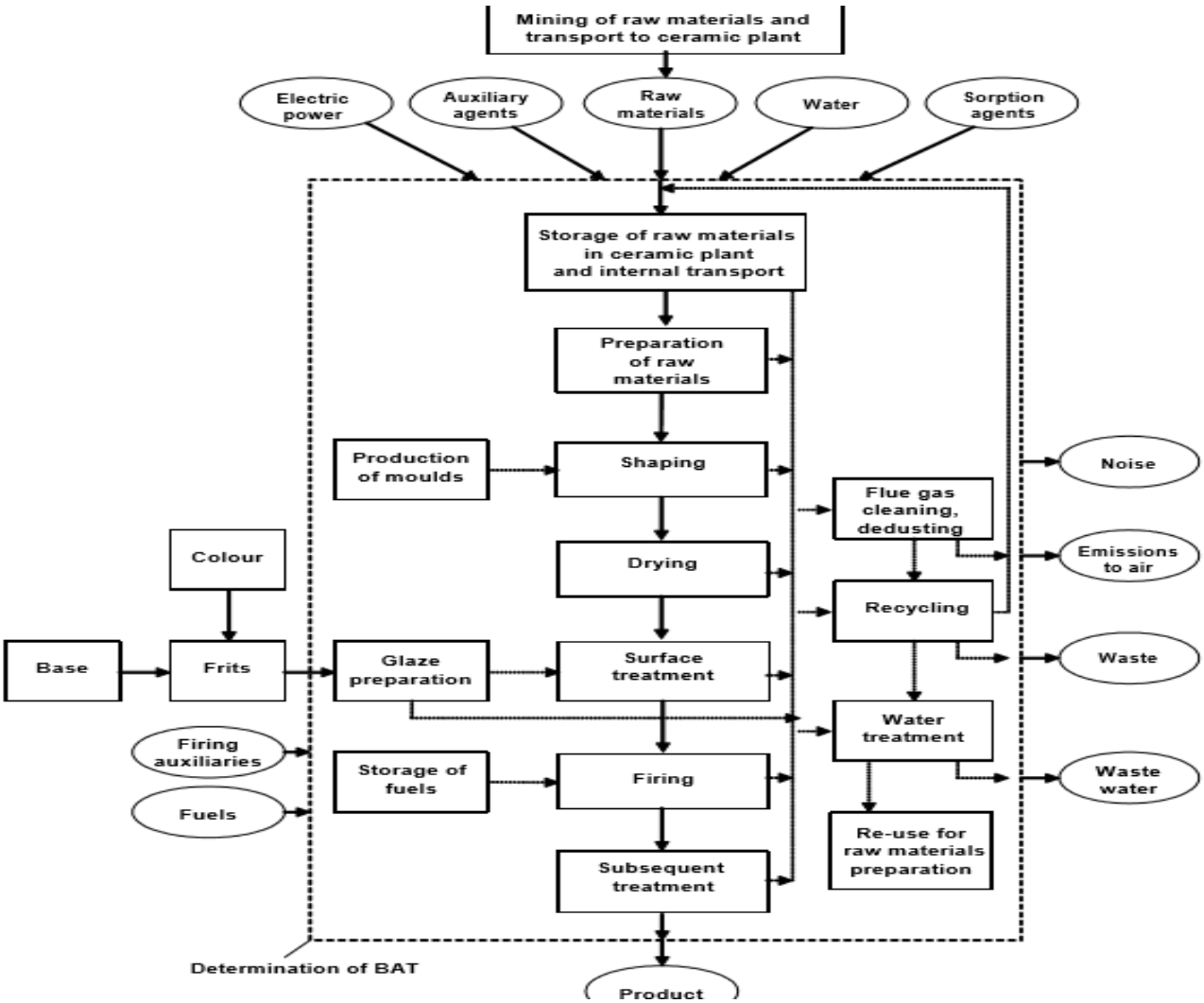


Figure 5: Environmental Based process diagram

3.0 DESCRIPTION OF PROJECT ENVIRONMENT

This section presents a description of the existing environment, including the bio-physical and socio-economic conditions of the project area. It also describes the condition of the access road within the located at Aboadze.

3.1 Methodology

Various techniques were applied for collecting data on the project environment. These included site visits, desk top document review, institutional consultations, focus group discussions and field survey of the existing environment. An account of the physical and biological environment and socio–economic conditions (ethnic groups, culture, economic activities, etc) were assembled. These formed part of the baseline information and the information obtained used in the environmental analysis/assessment. The description of baseline information relevant to the project covers:

3.2 Brief description of the Shama District

The Shama District was carved out of the former Shama Ahanta East Metropolitan Assembly (SAEMA) in the year 2008. The population of Shama District, according to the 2012 Population and Housing Census, is 81,966 representing 3.4 percent of the region's total population. The District is bounded on the East by Central Region, West by Sekondi-Takoradi Metropolitan Assembly, Mpohor Wassa East District on the North and Gulf of Guinea on the South.

3.3 Relief and Drainage

The propose ceramic tiles factory will be constructed on an industrial plot at Aboadze about 250 meter from Thermal power plant owned by Volta River Authority . Drainage from the site is not collected in any manner but instead is allowed to percolate through the fill and or runoff the sides into the vegetation.

3.4 Geology and Soils

The coastal areas have faulty shelves and sand stones of various types resting on a hard basement of granite, gneiss and schist. However, non-coastal areas have lower Birimian and granite soil minerals which when harnessed by investors, will go a long way to improve the construction industry in the District. Granite found in the Shama District can be divided into two groups namely: the Dixcove granite complex and the Cape Coast granite complex. These rock types occur in Appimenim, Ohiamadwen, Kwabena Andokrom, Anto, Aboso, Atwereboanda, Supomu Dunkwa, Assorku and Essaman. The map of the district is depicted in figure 6 below.

Figure 6: District Map of Shama

3.5 Climate

The district falls within the coastal savannah zone of Ghana. The climatic belt is marked by double maxima rainfall regime. The main rainy reasons are from May to mid-July with the wettest month being June, and second minor season from August to October. The mean annual rainfall ranges between 171cm to 185cm. The dry season occurs in the period when the entire country is under the influence of the Tropical Continental (TC) air Mass. This period is marked by the Harmattan season with cold nights and hot afternoons. The highest average monthly temperature is 34°C which is record between March and April, while the lowest average mean temperature is 20°C and is

occurs in August. Relative humidity is very high averaging between 75% to 85% in the rainy season and 70% and 80% in the dry season.

3.6 Air Quality

Air quality of the area is influenced by the location of the site, which is surrounded by undeveloped farming activities. Small scale farming activities predominantly influence on air quality at the proposed site.

3.7 Ambient Noise Level

The general noise level in this portion of industrial areais relatively low. This is explained by the fact that the area is surrounded by small scale farming activities that are focused on provision of services supply to local demand. The average ambient noise level measured at the proposed site are summarized in Table 3.7 and is currently well below EPA guidelines.

Table 3.7 Day time ambient noise measurements taken at proposed ceramic tile factory site

Location	Day Time Measurement dB(A)	Night Time Measurement dB(A)	EPA Guideline (Light Industrial)
North Site Boundary	46	40	70 day time
South Site Boundary	50	41	
East Site Boundary	45	40	60 night time
West Site Boundary	54	46	
Average	47	42	

Source: Minerals Commission (June 20, 2016)

3.8 Water Quality and Use

The proposed site is served by the Aboadze water distribution system. Surface water runoff at the site is currently across a vegetated ground and then directly into the surrounding natural drainage systems.

3.9 Vegetation

The area is largely a small scale farming community. However, there are patches of natural vegetation. The natural vegetation of the outlying district area has greatly been altered as a result of human activities, including slash and burn farming, construction of housing facilities and other industries such as timber processing, stone and sand extraction. The existing vegetation is broad woodland in the North and Central portions of the district. Along the coastal area, thickets intermingled with tall grass species is the predominant vegetation.

3.10 Demographic Characteristics

3.10.1 Population Size, Growth Rate and Density

The population of Shama District, according to the 2012 Population and Housing Census, is 81,966 representing 3.4 percent of the region's total population. Males constitute 47.2 percent and females represent 52.8 percent. Fifty eight percent of the population is rural. The District has a sex ratio of 89. The population of the District is youthful (14.4%) of the 0-4 age group, depicting a broad base population pyramid which tapers off with a

small number of the 60 plus years (3.7%). The total age dependency ratio for the District is 85, the age dependency ratio for males is higher (92.0) than that of females (79.0).

3.11 Environmental Quality

The proposed site is surrounded undeveloped plot. The site shares a property line with other lands of the Aboadze Industrial enclave and especially Ghana National Gas Company. Historically, the site appears to have been used primarily for small scale farming by community members.

3.12 Conditions of the Built Environment

The built environment in the immediate vicinity of the proposed project is reasonably orderly for a factory development of this kind. Roads are in reasonable condition.

Built areas in the adjacent district area can be classified into urban and rural settings. Generally, housing in the district can be classified into 1st, 2nd and 3rd class residential areas.

3.13 Socio – Economic Environment

About 69 percent of the population aged 15 years and older are economically active while 32 per cent are economically not active. Of the economically active population, 92.5 percent are employed while 7.5 percent are unemployed. For those who are economically not active, a larger percentage of them are students (48.8%), 19.5 percent perform

household duties and 12.7 percent are disabled or too sick to work. Almost seven out of ten (61.4%) of the unemployed are seeking work for the first time.

3.14 Cultural aspects

In 1960 over 100 linguist and cultural groups were recorded in Ghana. The five major ethnic groups include the Akan, Ewe, Mole-Dagbane, Guan, and Ga-Adangbe. The subdivisions of each group share a common cultural heritage, history, language, and origin. The Akan are the most numerous in Ghana, especially in the south, coastal regions; consisting of over 40 percent of the population. They are followed by the Ewe, Ga, Adangme, Guan, and Kyerepong in the south[1]. Due to high levels of in-migration to the urban area of Takoradi-Sekondi, there is a high diversity of ethnic groups.

In traditional society, women had considerable economic and political powers from their ability to control their own income and property without male oversight. The Akan are a matrilinear ethnic group, in which women regularly assumed a high status within the lineage and the kingdom, even though their authority was often confined to women's affairs. The social changes which occurred during the colonial period reduced the status of women and education levels, and as a result men are now better represented in government and formal employment. Christianity, Islam, and traditional African religions have roughly an equal number of believers in

1 Source: http://www.everyculture.com/Ge-It/Ghana.html#ixzz1Txe4uRJT

Ghana; however there are higher numbers of Christians in the coastal areas, including Takoradi. Festivals are important in the social life of the people of the Metropolis. The Kundum festival is celebrated by the Ahantas and witnessed by the citizenry during the occasion. It is organized in July – August every year. It relates to the celebration of bountiful food harvest and serves as an occasion for the indigenous people and others to strengthen their mutual bond for development. There is also in existence a masquerade group which display their skill at all occasions such as Christmas and Easter celebrations. It serves as source of entertainment as well as serves an important source of income generation for the community

3.15 Road Infrastructure

The proposed development site is entirely accessible by reshaped laterite surface road. Within the broader district area, roads are variously constructed from asphalt road, bitumen (with stone aggregates) and laterite surfaced roads. Major roads in the central business district are asphalt roads. Other minor roads in the central business district and other residential areas are bitumen surfaced. Laterite roads are mainly located in the newly developing areas and roads leading to smaller communities within the metropolis.

3.16 Accessibility

The main entrance to the proposed facility is access by an unconstructed road within the industrial enclave and the access road is currently being designed.

3.17 Land Use

Land use at and adjacent to the proposed development site is associated with undeveloped land own and industrial.

3.18 State of the Site

The proposed site for the project is entirely undeveloped area. The site is served by existing supplies of water. However, there are no electricity and telecommunication service.

4.0 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

The assessment process evaluated the potential impacts and other issues and concern that could arise from the operation of the facility. Stakeholder involvement played a major role in the identification and analysis of the potential impact of the proposed project.

The potential adverse impacts include the following:

- ✓ Potential impact on air quality
- ✓ Potential impact on water quality and use.
- ✓ Potential noise generation
- ✓ Potential fire and explosion risk
- ✓ Occupational Health and Safety concerns
- ✓ Waste Generation and Disposal
- ✓ Vehicular traffic concern; and
- ✓ Potential infection rate increase in HIV/AIDS cases

Positive and potentially adverse effects are discussed in detail in the sub-sections which follow.

4.1 Positive Impacts

4.1.1 Waste Reduction

The proposed technology will reduce the amount and toxicity of potentially hazardous waste being disposed of into the environment. The proposed ceramic tile production facility will produce very little waste into the environment.

4.1.2 Employment Opportunities

The total permanent work force for the operation is expected to be two thousand (2,000) direct jobs and 5,000 indirect jobs. This workforce will consist of three (3) management positions and seven (7) technical staff. The rest will be semi-skilled workers. However, depending on the exigencies, casuals will be engaged but not more than two thousand (2,000).

4.1.3 Capital Injection into the Economy

The proposed project will contribute to the local economy primarily through wage related employment during the installation and operations phase. Additional revenues will accrue to local permitted scrape dealers and foundries which will also find its way into the local economy. The project will also contribute substantial millions of dollar into the economy.

4.2 Potential Adverse Impacts

4.2.1 Potential Impact on Air Quality

Since the production involves, grinding and spraying, some level of gas phase end products is expected from the process.

The production of ceramic tile is a wet process. Small quantity of aerosols is expected from the spraying activities. In the absence of proper controls and management the facility would have potential to release more organic hydrocarbon vapors. Emissions characteristics will vary according to the inherent qualities of the sprays being used. Table 4.2.1 sets out the Ghanaian guidelines for SO_2, NOx and Particular Matter (PM_{10}) that **Twyford (Ghana) Ceramics Company Limited** will need to comply with, annually, monthly and over a 24 hour period. Tables 4.2.1 and 4.2.1-2 sets out the Ghanaian guidelines in the workplace for CO, NOx, PM_{10} and SO_2.

Table 4.2.1 Ghanaian Emissions Guidelines

Parameter	Annual Geometric Mean	Monthly Average during Harmattan	Max 24 hour average
	Industrial/ Commercial Limits	Industrial/ Commercial Limits	Industrial/ Commercial Limits
SO_2 (µg/m^3)	50	125	350
NOx (µg/m^3)	50	125	350
PM10 (µg/m^3)	200	500	260

Table 4.2.1-2: Ghanaian work place emission guidelines

Air Quality Indicator	Work Place Guideline
CO **(mg/m³)**	**29**
NOx **(mg/m³)**	**9**
SO_2 **(mg/m³)**	**13**
PM10 **(mg/m³)**	**10**

4.2.2 Odours

Odour emissions in the area of the spraying unit cannot be excluded completely. However, these emissions will be substantially reduced because spraying will be carried out in a special unit that will minimise or prevent odour release into the atmosphere. Improper storage of garbage resulting in odour problems may also occur and may also generate odour.

4.2.3 Dust

In the absence of hardened surfaces or dust control, frequent transit of office and client vehicles could also result in generation of nuisance dust.

4.2.4 Potential Impact on Water Quality and Use

The proposed facility will be partly covered in a building and not exposure to rains. The facility will have a concrete lip or curb around it offering further containment. The only exposed area will be the parking area.

The facility will employ approximately 20 workers and it is anticipated that daily domestic water use will be approximately 1000 to 2000 litres/day depending on activities. Domestic water will be obtained from the existing water supply system serving the area. This Eshiem water distribution system is currently under planned upgrade.

4.2.5 Potential Noise Generation

Noise will be generated from the operation of the factory as well as from the periodic movement of vehicles. The factory will be within partly enclosed structure. Measurements taken inside and outside an active ceramic tile production factory in Spain are summarized in Table 4.2.5.

Table 4.2.5: Ambient noise measurements taken inside and outside an active, ceramic tile site

Location	Factory Measurements (dB(A))	Existing Average Day /Night Ambient Measurement (dB(A))	EPA Guideline (Heavy Industrial) (dB(A)
Average measurement **inside** typical **Ceramic tile**	86	**49/44**	**70** day time **70** night time
Maximum ambient **outside** values measured at approximately 50m from an operating facility	65		

4.2.6 Potential Fire and Explosion Risk

Potential source of fire outbreak during operation include fire from electrical cables, inappropriate use switches and storage of fuel for power generator. Vapour containment and management systems, active monitoring, ventilation and fire control systems will minimize any potential for an explosion. Smoking within the facility will not be permitted.

4.2.7 Occupational Health and Safety Concerns

The operation and maintenance of the facility has various aspects of relevance to worker occupational health and safety. These risk factors are:

- ✓ rotating equipment;
- ✓ noise generating processes;
- ✓ exposure to dust and organic vapours and
- ✓ Complex steel framing at various heights and exceeding 1.5 m in height.

These risk factors introduce potential for the following injuries:

- ✓ entanglement;
- ✓ auditory impairment;
- ✓ respiratory impairment;
- ✓ burns; and
- ✓ Abrasion, cuts, tripping, slips and falls.

4.2.8 Waste Generation and Disposal

4.2.8.1 Solid Waste

Solid waste that will be generated at the site will include, empty paint cans, office waste, food waste, packing material, clay and maintenance waste such as PVC pipes, Scraps and wires. Unmanaged solid waste at the project site can create fire hazards, hygiene related problems, attract rodents/insects/snakes, create odour problems, create risk of tripping, trauma, cuts, spread litter to other sites, and create a visual eyesore. The domestic waste will be collected by Zoomlion, the current approved waste collector for the area and disposed of at the Sofokrom Municipal Landfill. Scraps and other metal will be sold to license vendors for use at the foundries located in Takoradi and Tema.

4.2.8.2 Liquid Waste

During operation it estimated to use about 2,000 to 5,000 liters of water per day primarily through use for employee domestic use (toilets and personal washing), production and periodic wash down of site. The effluent from the domestic systems will be pumped into holding tanks and then collected by the local service providers for disposal. Effluent from the factory will be treated to meet Ghanaian EPA standards for disposal into drainage around the factory. The effluent treatment system to be utilised will involve sedimentation and a chemical treatment ponds.

4.2.9 Vehicular Traffic Concerns

The movement of staff vehicles will somewhat congest the parking area and would pose a normal vehicle related hazards.

4.2.10 Oil Spillage

The manufacturing equipments contain oil for proper functioning. During servicing extremely care will be taken to prevent oil spills.

5.0 Mitigation Measures

The assessment considered a number of mitigation and enhancement measures for incorporation in the project design and implementation. This section presents the mitigation measures that will be implemented to address the potential significant adverse environmental impacts, in order to make the project socially acceptable, environmentally sound and sustainable. The mitigation and contingency measures considered include:

- ✓ Air Quality Protection Measures;
- ✓ Water Quality Protection, Spill Prevention and Response;
- ✓ Noise Reduction;
- ✓ Fire and Explosion Risk Reduction;
- ✓ Occupational Health and Safety Measures;
- ✓ Waste Reduction, Storage and Disposal Practices;
- ✓ Traffic and Vehicle Controls;
- ✓ Oil Spills and
- ✓ Loss of site by local repairs

5.1 Air Quality Protection Measures

The ceramic tile factory is designed specifically to recapture and condense liquids and associated volatile components such that they do not get released directly to the environment.

Electronic Data Verification (EDV) based supervision of the modules will be used to ensure optimal functioning of the facility and control of emissions. The

EDV system can relay malfunctioning messages that result in an instant interruption of the process. The permanent convectional air exchange in the operational area is sufficient to dissipate any residual fugitive emissions.

In cases where personnel may be exposed to excessive dust or other contaminants appropriate personal protective equipment will be supplied and required.

5.2 Water Quality Protection, Spill Prevention and Spill Response

As discussed, the proposed ceramic tiles production facility will be in a partly covered structure and not exposed to rain.

Emergency spill response supplies and procedures will be in place at the facility. Staff will be trained in emergency response hazards for spills and other forms of emergency.

The facility will employ approximately 20 workers and it is anticipated that daily domestic water use will be between 2,000 - 3,000 litres/day. Domestic water will be obtained from the existing water supply system serving the Aboadze community.

Some natural site runoff from hardened surfaces will also occur during rainfall events although this will not come in contact with the waste stream. Standing water on site could serve as a breeding ground for disease carrying insects and therefore will be dislodge to the sanitary landfill site for treatment and disposal.

5.3 Noise Reduction

The noise levels produced during operational phase will be mitigated by housing of main noise generating equipment in a building and provision of hearing protection to workers. The use of electrical power rather than having on site diesel generator will also reduce the noise profile of the facility. All equipment will be well maintained to ensure operability and to minimize generation of unnecessary noise.

5.4 Fire and Explosion Risk Reduction

Fire/Explosion prevention is a concern and as such the basis of design of the facility will include:

- ✓ hydrocarbon vapour containment and management systems;
- ✓ active monitoring;
- ✓ ventilation;
- ✓ smoke detectors; and
- ✓ Fire extinguishers and fire hose.

Additional measures will include:

- ✓ worker training and drills in emergency response and fire fighting;
- ✓ identification of a specific assembly point (muster station); and
- ✓ Smoking will not be allowed in the facility.

The local emergency service infrastructure, especially the Ghana National Fire Service (**Aboadze**) personnel will be relied on to address cases beyond the control of **Twyford (Ghana) Ceramic Company Limited.**

5.5 Occupational Health and Safety Measures

As discussed previously, the proposed facility will have some risk factors that, in the absence of mitigation, could result in impairment of worker health and safety. Those risk factors are:

- ✓ Entanglement in rotating or moving equipment;
- ✓ auditory impairment;
- ✓ respiratory impairment;
- ✓ burns; and
- ✓ Abrasion, cuts, tripping, slips and falls.

Mitigation measures to be applied will include:

- ✓ incorporation of safety features into facility design;
- ✓ fixed restraints and shielding in proximity to high risk areas/equipment;
- ✓ safety marking;
- ✓ work force training and competency assurance;
- ✓ provision of and mandatory use of proper personal protective equipment (PPE), such as hard hats, safety boots, safety glasses, safety harnesses/fall restraints, flame-resistant coveralls, gloves, and particle masks;
- ✓ maintaining site in a clean and orderly fashion;
- ✓ regular inspection and maintenance of all process and safety equipment;

- ✓ posting of HSE signage and notices; and
- ✓ HSE related monitoring, reporting (*e.g.* incident investigation, near miss reporting *etc*) and follow-up.

5.6 Waste Reduction, Storage and Disposal Practices

Sanitary liquid waste will be contained, subject to septic treatment and removed for disposal by contract waste hauler to approved disposal facility.

Waste bins would be strategically placed at the site during the installation and operational phases. These will be adequately covered to minimize odour and prevent access by vermin. The bins will be emptied twice weekly by Zoomlion during the installation phase and once weekly or more frequently as required during the operational phase to prevent undue accumulation and decomposition.

Where possible, all solid waste will be segregated into organics, metals or plastics for collection by approved recycler for final disposal. All liquid waste will be trapped into septic tanks, collected and disposed of by approved contractors. Guidance and signage will be provided, to all workers, on segregation to ensure that the wastes are not mixed up at the site.

5.7 Vehicular Traffic Control

The proposed facility has been designed to adequately accommodate staff parking. Staff will be assigned to coordinate movements in and out of the

facility. Proper traffic control signage would be used on site and approaches to the site.

All drivers will receive defensive driver training which meets international standards. They will be expected to adhere to all port requirements and be monitored on a periodic basis to ensure their compliance. Annually they will undertake refresher training.

6.0 ENVIRONMENTAL MONITORING

The significance of an environmental monitoring plan for a project is to provide room for assessing the accuracy of assessed impacts, implemented mitigation measures and to allow for prompt corrective action to be taken to correct deviations in the impacts that might have been overlooked during the PEA so that appropriate mitigation measures are put in place to ensure efficiency and sustainability.

The site manager will be designated as the overall Environmental Service, Health, and Safety & Training Manager for the site. **Twyford (Ghana) Ceramics Company Limited** will also designate one employee as an HSE Officer, who, in addition to regular work requirements will also be responsible for helping to address HSE-related issues. Monitoring will be done throughout the implementation stage of the project and will focus on the following:

- ✓ Air emissions, air quality
- ✓ Waste generation and disposal
- ✓ Occupational health and safety; and
- ✓ Fire/explosion risk monitoring
- ✓ Spill/accidental release risk monitoring
- ✓ Noise

6.1 Air Emissions & Air Quality Monitoring

Air emissions associated with the proposed facility will be monitored at intervals for the life of the facility. A record of annual Scope 1 and Scope 2 Emissions (as per global Carbon Disclosure Project) will be maintained by **Twyford (Ghana) Ceramics Company Limited**.

6.2 Waste Generation and Disposal Monitoring

The designated HSE Officer will monitor and evaluate waste generation and disposal regime during the operation of the project. Records on the quantity and quality of solid waste generated, time of ultimate removal, and chain of custody tracking will be undertaken and a record maintained.

He or she will also monitor and document the collection and temporary storage of domestic solid waste associated with the day to day use of the facility, as well as general housekeeping at the facility. The person will be responsible for monitoring the state of hygiene in wash rooms and kitchen/coffee room areas. Corrective actions will be undertaken as needed to ensure the facility is clean and well operated.

6.3 Occupational Health and Safety Monitoring

Monitoring activities will be carried out in order to maintain the health and safety of all workers. These include:

- ✓ Records of work related injuries such as cuts, falls, burns, electrical shocks and other injuries as well as near misses will be maintained and

reviewed. Corrective action and responsible parties for those actions will be identified as part of the incident investigation.

- ✓ The Environmental Service, Health, Safety & Training Manager and HSE Officer will monitor the use of appropriate PPE.
- ✓ Monitoring and documenting of any environmental incidents, as well as close out actions undertaken to clean up or mitigate impacts.
- ✓ Induction and training programs will be monitored to ensure that all workers receive inductions and appropriate training for the work to be undertaken.
- ✓ Daily tool box HSE meeting records will also be reviewed from time to time to identify needs of workers and address them appropriately.

6.4 Fire and Explosion Risk Monitoring

Regular inspection will be conducted on all electrical appliances and connections such as switches, panel boxes, the Electronic Data Verification System and other equipment. Periodic recalibration will be undertaken as per the manufacturer's recommendations as well as where warranted by observations on site.

Fire extinguishers will be located in strategic places based on a fire risk assessment to be undertaken when operations commence. All fire extinguishers will be inspected quarterly and where expired ones are found, they will be replaced.

Fire drills and environmental incident drills will be organized periodically as part of the training program. Corrective action will be undertaken where monitoring of emergency response drills indicate deficiencies.

6.5 Spill/accidental Release Risk Monitoring

All incidents and accidents will be recorded and kept for future reviews and incorporated in the annual report. Clean up and any remedial measures will be implemented to minimise any adverse impacts. The causes of the incidents/spill will be analysed and measures will be put it in place to reduce the probability of reoccurrence.

6.6 Noise Monitoring

The use of appropriate PPE for noise protection will be closely monitored. Maintenance plan for all equipment and machinery will be developed. All equipment will be regularly inspected based on this plan to ensure that regular maintenance is followed to reduce noise from operations.

7.0 PROVISIONAL ENVIRONMENTAL MANAGEMENT PLAN

7.1 Objective of the Plan

The objective of this Provisional Environmental Management Plan (PEMP) is to present the mitigation measures and monitoring requirements and other responsibilities in an actionable mode for implementation during the construction and early phase of project operation. The PEMP defines steps that will be followed to ensure that environmental obligations and stewardship responsibilities are discharge.

The validity period for a PEMP is eighteen months from the commencement of the project in accordance with section 24(1) of the LI 1652, 1999. The PEMP will be converted into a sustainable Environmental Management Plan (EMP) within the eighteen – month period and submitted to the EPA for approval.

The provisional EMP will cover:

- ✓ Water resource management
- ✓ Fire and explosion risk management
- ✓ Occupational health and safety management
- ✓ Oil spillage
- ✓ Waste generation and disposal and
- ✓ Traffic control

The relevant scope of the PEMP for the project would include the following

- ✓ Measures proposed to mitigate environmental impact

- ✓ Monitoring plans
- ✓ Emergency response plan
- ✓ Schedules for implementation of specific actions (including mitigation and monitoring)
- ✓ Training and capacity building needs
- ✓ Roles and responsibilities for various actions
- ✓ Documentation and reporting requirement; and
- ✓ Financial requirement for implementation of plans

The plan constitutes an important component of the company's overall management system for the project. The success of the company's environmental performance during the life of the project is contingent on the effective implementation of this provisional plan and the subsequent EMP. The PEMP is summarized in Table 7.1.

Table 7.1 Summary of Provisional Environmental Management Plan

Management Area	Impact Area	Mitigation/Monitoring Action & Requirement	Implementation & reporting Schedule	Responsibility
Fire/Explosion Management	• Facility Site and Adjacent	• Monitor the storage of flammable or combustible materials, any hazardous materials and critical processes • Ensure functionality	Daily Daily Bi-monthly	HSE Officer

		of Electronic Data Verification System • Emergency Response Drills		
Water resource management	• Facility Site and Adjacent	• Monitor use of water resources • Inspect and manage facility to ensure no contaminated water is allowed to be discharged from facility • Crew trained in emergency spill response and necessary supplies and procedures maintained on site.	Monthly Weekly after wash down	HSE Officer
Air quality	• Facility Site and Adjacent	• Monitor Scope 1 and Scope 2 Emissions • Require PPE as appropriate to exposure. • Ensure facility operates at high efficiency	Monthly	HSE Officer
Noise	• Facility Site	• House key noise generating equipment in building • Require PPE as appropriate to exposure	Continuous	HSE Officer

Waste Management	• Waste generation(solid, liquid, & hazardous waste)	• Ensure waste generated are being properly handled and stored until final disposal. • Ensure chain of custody tracking for all hazardous waste. • Ensure provision of waste bins, waste segregation, transportation and disposal of waste. • Inspection of primary waste storage sites	Continuous	HSE Officer
Occupational Health and Safety	• Accident resulting in injury • Electrical Shocks • Noise from Machinery	• Implement HSE Management System • Hold Tool box (Safety) meeting • Monitor accident records and close out • Ensure accidents and incidents are properly recorded, investigated and closed out • Provision and use of PPE. • Monitor Maintenance of Machinery	Continuously Twice a week As they occur As they occur As required Weekly	Environmental Service, Health, Safety & Training Manager HSE Officer

Traffic control	• Traffic accidents	• Ensure defensive driving courses are undertaken by all drivers • Ensure accidents and incidents are properly recorded, investigated and closed out	Annually	HSE Officer

7.2 Management Structure and Implementation

TWYFORD (Ghana) Ceramics Company Limited will assign responsibilities to the following personnel for day to day running of the project (especially in relation to the environment responsibilities);

7.2.1 Facility Operations Manager / Environmental Service, Health, Safety & Training Manager

- ✓ Ensure compliance with all safety rule and regulations.
- ✓ Ensure HSE related training programs are adequately resourced and implemented
- ✓ Ensure HSE Management System is implemented
- ✓ Provide management oversight for HSE function
- ✓ Ensure work environment is efficient, safe and worker friendly.
- ✓ Resolve any matters arising with the fishing port authority or other area users.

7.2.2 HSE Officer

- ✓ Train all personnel according to the works to be executed, to perform a safe and environmentally sustainable work
- ✓ Ensure the PEMP and other HS documents are implemented
- ✓ Investigate accidents and incidents that may occur so they do not happen again;
- ✓ Provide advice and assistance on OHS to all employees.
- ✓ Conduct fire drills and inspect all fire-fighting equipment from time to time.
- ✓ Conduct environmental incident drills.
- ✓ Evaluate and control the compliance of the Safety program followed by employees;
- ✓ Implement norms about personal protection
- ✓ Prepare and participate in safety and environmental meetings
- ✓ Ensure all required environmental, health and safety monitoring is undertaken
- ✓ Maintain records about use and maintenance of the PPE.
- ✓ Prepare safety information about all the products used for the project based on Material Safety Data Sheets (MSDS's)
- ✓ Ensure compliance with all safety and environmental rules and regulations.
- ✓ Ensure relevant HSE notices are posted on site and adhered to.

7.2.3 0ccupational Health and Safety

Occupational health and safety management will include the following:

- ✓ Implementation of HSE Management System
- ✓ Tool box (Safety) meeting will be held twice a week.
- ✓ A first aid team will be formed to provide first aid service to workers. Training needs of this team will be assessed by the Environmental Service, Health, Safety & Training Manager and the Takoradi health directorate involved in offering this training.

7.3 Waste Management Plan

The HSE officer shall organize training for the staff on waste handling and disposal, while pursuing periodic sensitization at departmental level, to achieve a clean and safe environment. He or she shall conduct an annual review of the training to ensure that workers comply with laid down procedures with regards to waste management.

Considering the management of solid and liquid waste, **Twyford (Ghana) Ceramics Company Limited** will institute effective measures to deal with the various types and quantities of waste that will be generated. This would involve the collection, segregation (where possible), primary storage, transportation and necessary arrangements for disposal.

8.0 CONCLUSION

This Preliminary Environmental Report has been compiled according to Environmental Regulations of Ghana.

The environmental assessment identified the following as potential environmental issues

- ✓ Solid and liquid waste management
- ✓ Potential fire and explosion risk
- ✓ Air pollution
- ✓ Noise pollution
- ✓ Water management and quality and
- ✓ Vehicular traffic

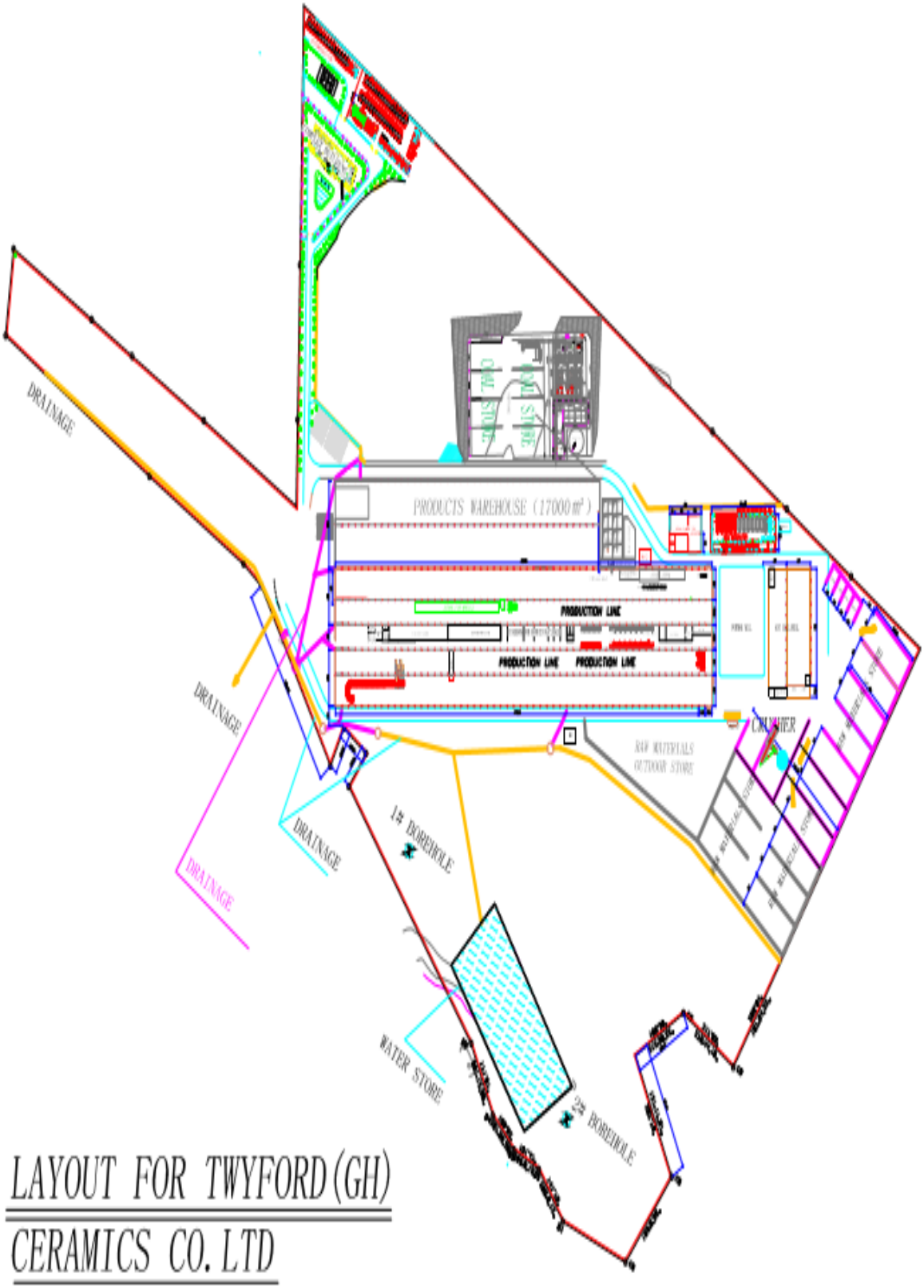
In order to mitigate the above impacts **Twyford (Ghana) Ceramics Company Limited** will implement an environmental, health and safety action plan during the operational stage of the project. This plan will incorporate all of the mitigation measures described above including emergency response plans. This commitment will ensure mitigation of all substantive impacts and ensure an environmentally successful project.

9.0 REFERENCES

1. HPI. 2009. *Environmental Impact Assessment: Takoradi Thermal Power Plant Expansion Project*
2. http:/www.ghanadistrict .gov. Retrieved 10th March 2011.
3. http://www.everyculture.com/Ge-It/Ghana.html#ixzz1Txe4uRJT
4. International Finance Corporation. 2007: *Environmental, Health and Safety Guidelines: General EHS Guidelines: Environmental.* April 30, 2007.

APPENDIX 1

(FACILITY LAYOUT PLAN)


DRAINAGE
OIL STORE
ACID STORE
PRODUCTS WAREHOUSE (17000㎡)
PRODUCTION LINE
PRODUCTION LINE
PRODUCTION LINE
DRAINAGE
DRAINAGE
DRAINAGE
CRUSHER
RAW MATERIALS OUTDOOR STORE
1# BOREHOLE
WATER STORE
2# BOREHOLE
LAYOUT FOR TWYFORD (GH) CERAMICS CO. LTD

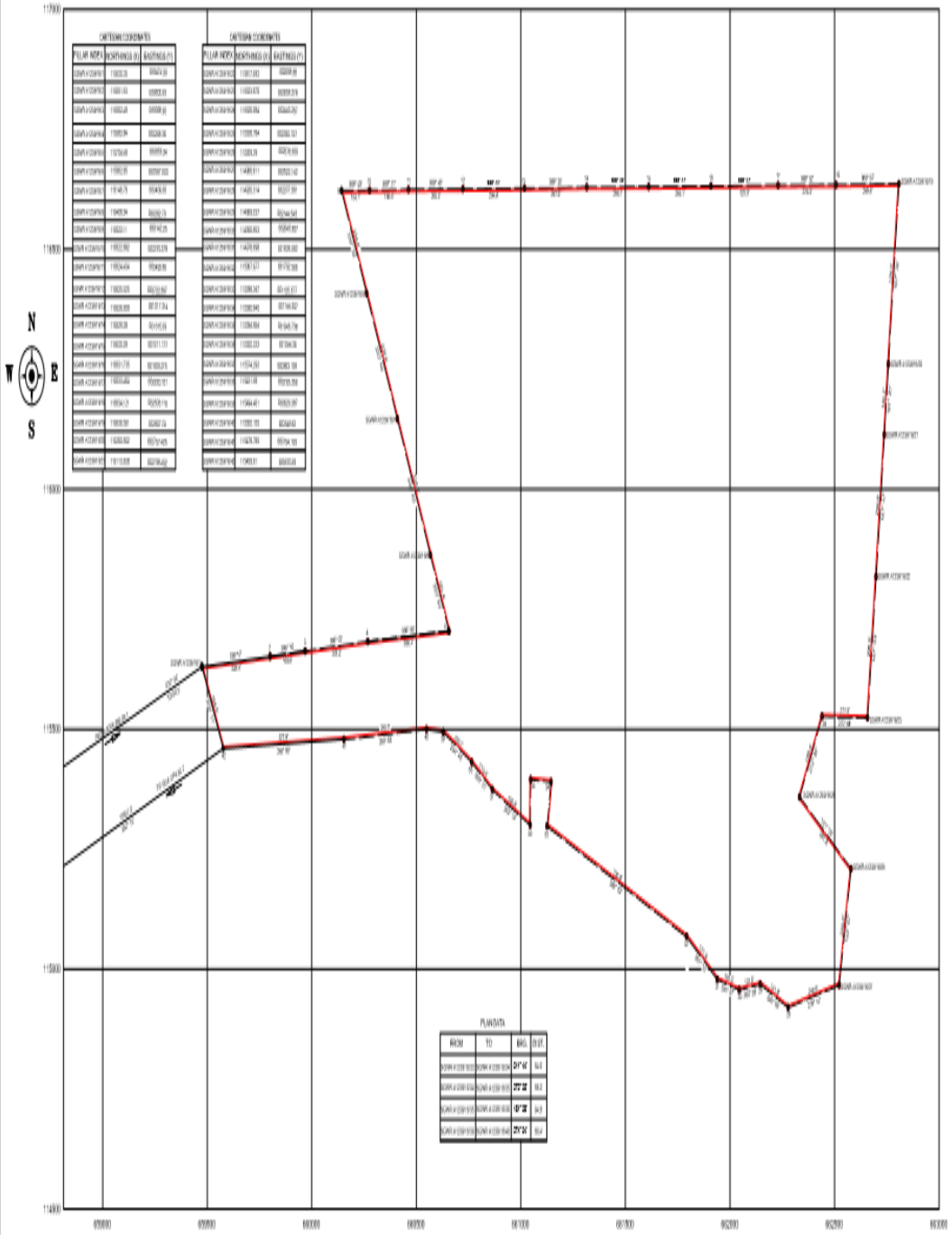
APPENDIX II

(SITE PLAN)

FOR : TWYFORD (GHANA) CERAMICS COMPANY LIMITED

SCALE - 1 : 2500 -Shewn Edged Pink- Area= 78.59Acre OR 31.81Hect.

LOCALITY	DISTRICT	REGION
EAST INCHABAN	SHAMA	WESTERN



I, D. O. ASIEDU Licensed Surveyor certify that this plan is faithfully and correctly executed and

APPROVAL SEAL:

APPROVED BY:

APPENDIX III

(CONSULTATION WITH SHAMA DISTRICT ASSEMBLY)

SHAMA DISTRICT ASSEMBLY

(S.D.A.)

OUR REF: SDA/DEPT.24/VOL1/ADMIN/004

YOUR REF:.....

P. O. BOX 37
SHAMA

TEL: 031 – 2093236
031 – 2092060
FAX: 031 – 2046908

www.shamadistrict.gov.gh REPUBLIC OF GHANA

11TH March, 2016

Dear Sir,

RE: APPLICATION FOR CHANGE OF USE: PARCEL OF LAND SITUATE AT ABOADZE FOR TWYFORD (GHANA) CERAMICS COMPANY LTD

Reference to your letter No. SD/TKD/SHM/16001 dated 24th February, 2016 requesting for a change of Land Use from residential to Industrial and Commercial purpose of a 78.61 acres of land situate at Aboadze.

I write to confirm that the Town and Country Planning Department of the Shama District has considered your application and has granted same.

I therefore do not have any objection to the site being used for **INDUSTRIAL/COMMERCIAL PURPOSES ONLY.**

DISTRICT TOWN AND COUNTRY PLANNING OFFICE SHAMA

JONES RICHARD JOHN (MGIP)
TOWN AND COUNTRY PLANNING DEPARTMENT
SHAMA DISTRICT ASSEMBLY