CHEMICAL AND PETROCHEMICAL INDUSTRY

1. The chemical and petrochemical sector includes a variety of processing methods and certainly is the most diverse in the world but not sufficiently represented in West Africa industry. This area can be divided as follows:
   (a) inorganic chemicals,
   (b) organic chemicals
   (c) petrochemicals
   (d) fine chemicals, pharmaceuticals, synthetic dyes and explosives.
   In these guidelines, the fertilizer industry, although part of the chemical and petrochemical sector is not included. This sub-sector is addressed in the guidelines entitled "plant fertilizer".

2. The group includes inorganic chemical production of chlorine or alkali, calcium carbide, inorganic acids, salts, phosphorus and its compounds, peroxide, inorganic pigments and manufacture of many products from metal salts of the acids mentioned. Inorganic chemicals, such as ammonia, nitric acid, urea and phosphoric acid are discussed in the section that deals with the production of fertilizer.

3. Petrochemicals are a distinct class of organic chemicals. Most are produced from petroleum, natural gas or coal, and many of them are produced in large quantities on a global scale (from 1 000 tonnes per year for specialty chemicals and 500,000 tons per year for commodities).

4. Lots of petrochemical products require storage of liquids or gas installations. This is the case, for example, ethylene, methanol, ethanol, acetic acid, acetone, adipic acid, aniline, benzene, caprolactam, chlorine compounds and fluorine-containing aliphatic or aromatic bodies of dinitro-trinitro-toluene, formaldehyde and alcohols. The solid products include synthetic resins, plastics and elastomers, rubber, melamine, nylon, polyester, polyolefins and polyvinyl chlorides. Products such as cellulose and chemicals made from sugar, even if they are not petrochemicals may, however, be arranged under this category.

5. The fine chemicals and pharmaceuticals form a separate group mainly due to the industrial method they require. They are usually made in small quantities from petrochemicals, natural substances or inorganic chemical elements. To this group belong the olfactory or synthetic aromatic compounds, synthetic dyes, pharmaceutical intermediates and final products.

6. In general, modern manufacturing chemicals require the construction of independent treatment plants to recycle water, once physical or chemical processes have reduced pollutants to an acceptable level of concentration. The

storage facilities should preferably be designed and constructed by providing containment equipment, such as double wall tanks, containment structures, concrete walls and leak detection devices.

Potential impacts on the environment

7. Most of the materials used in the manufacture of chemical and petrochemical products are flammable and prone to explosion substances. While many of these products are toxic, there are a few that are also carcinogenic. Explosion risks are much greater than in the case, for example, a refinery, since the compounds are highly reactive and their production and handling require attention

8. Should be considered highly toxic substances that cause instant accidents, such as phosgene or chlorine, as a risk to the safety of personnel. Others have long-term effects, even at low concentrations. Studies on the chemical manufacturing and its impact on the environment have shown that toxicity issues, risks and operational considerations played an important role. Waste and emissions may be produced depend on the types of compounds produced as well as the diversity of processes and chemicals used.

9. The chemical industry uses huge volumes of water used in manufacturing processes, cooling and washing. The water used in the manufacture of chemicals is usually polluted by these chemicals or their byproducts. The Agency for Environmental Protection of the United States (U.S. Environmental Protection Agency) has published a list of compounds for which effluent standards have been established. Among the pollutants that can pose a threat if they are discharged into rivers and groundwater, are toxic priority pollutants, carcinogenic compounds and suspended solids and solids which biochemical oxygen demand (DBO) and chemical oxygen demand (DCO) is very high.

10. Resources in surface or underground water are subject to risks posed by rainwater flowing oil reservoirs, production waste from manufacturing facilities, pipe leaks, discharge of cooling water, leaching and clean, and the spillage of raw materials and finished products. Measures to control runoff include, for example, to create pools of storm water equipped with water treatment plant before discharge, usually are needed and avoid such risks for resources water.

11. The air pollutants depend on the manufacturing process used and include particles and a large number of gaseous compounds such as oxides of sulfur, carbon and nitrogen released from flue boilers and furnaces manufacturing of

ammonia, and nitrogen compounds and chlorine. These emissions come from various sources, including manufacturing equipment, storage facilities, pumps, valves, vents and defective seals.

12. Incineration processes (flares), adsorption, gas cleaning and other absorption methods are used to fight against air emissions. The Agency for Environmental Protection of the United States (U.S. Environmental Protection Agency) has established quality standards to regulate air emissions from chemical plants.

13. The solids produced by the chemical industry waste residue may consist of raw materials, polymer waste; sludge from the substances used for boiler feed, materials scrubbing tanks or produced by pollution control equipment and ash from coal-fired boilers. Chemicals can contaminate the waste produced by manufacturing processes. Disposal of spent catalysts that are used in petrochemical industries may create a problem for the environment. Today, most manufacturers have to recover.

Special issues

Hazardous Materials Management

14. There are cases where the waste is likely to represent a biological or radioactive hazard. The bio -industrial and pharmacological waste containing, for example, micro- organisms, viruses and radioactive substances may pose a risk if they are not disposed of properly. The following practices should be instituted when it comes to managing the disposal of this type of solid waste :
    - should have appropriate facilities for treatment, storage and disposal of hazardous or radioactive materials;
    - the borrowing country should , on one hand , have developed (or adopted in developed countries) and established regulations and standards governing the operation of these facilities and secondly , be able to ensure compliance;
    - laboratories and other support facilities should exist to collect and analyze samples of environmental resources.

15. Production of explosives or highly reactive chemicals raises specific issues. The design plans must take into account the risk of equipment failure and provide explosion and fire walls to reduce environmental hazards and health both in the workplace and outside thereof.

16. It often happens that the specific environmental problems are created by chemical plants where materials are prepared from specific blends to meet market demand. Plants pesticides, solvents and explosives are examples. The procedures for environmental, health and risks to be applied to such plants should be the same as for the chemical manufacturer of mixed compounds (for further details, refer to "Managing hazardous Materials ").

Reducing the volume of wastewater

17. Two types of measures adapted to a plant can greatly reduce the volume of wastewater. The first is to recycle water from a process to another, using, for example, water drain of high pressure boilers as boiler fuel at low pressure, or using as much as possible the wastewater as extra resources. The second seeks to devise ways to recycle water always at the same end. The use of the water produced by the cooling towers and the use of condensed steam to power the boilers are examples.

18. Allied to good maintenance practices suitable operating methods also help to reduce the volume of wastewater. One can, for example, reduce waste by studying the range of products, using vehicles equipped with suction devices or methods of dry cleaning spills, applying inspection procedures and maintenance to reduce leakage and finally isolating the waste stream requiring special attention in terms of their disposal (such as spent degreasing solution).

Noise

19. Chemical and petrochemical industries can generate significant noise. The high-speed centrifugal compressors, rotary screw compressors, control valves, pipe networks, gas turbines, pumps, furnaces, air exchangers heat recovery, cooling towers and ventilation devices are sources of noise. Noise levels ranged between 60 and 110 dB at a distance of one meter. While soundproofing is often the most practical solution for this problem, it is that sometimes the manufacturers have a range of equipment with low noise emission.

Picture: Summary of Impacts and Mitigation measures

Potential negative impacts		Mitigation measures
Direct impacts: Choice of location		
1	Location of industry on or near sensitive habitats: mangroves, estuaries, wetlands and coral reefs.	• Choose a location that is as far as possible, in an industrial area, so as to reduce or concentrate pressure on local resources and to facilitate the control of substances released. • Involve natural resource agencies to choose the location for the consideration of alternatives.
2	Location of facilities along the river can cause degradation.	• The choice of location should explore opportunities to minimize the consequences for the environment and does not impede the use of water. • There is a need to locate facilities that emit liquid waste near a stream with a capacity to assimilate waste is adequate.
3	Location can create severe weather problems in the region.	• Implement the facilities in an area that is not subject to air inversions, which does not collect pollutants and where prevailing winds are moving towards relatively sparsely populated regions.
4	Location could exacerbate problems of solid waste disposal in a region.	The choice of location should assess it taking into account the following guidelines: • size of the field for a landfill or disposal site • sufficient discharge near • accessibility for the public and private services may collect and transport solid waste to its final destination.
Direct impacts : Plant operation		
5	• Water pollution caused by the discharge of liquid effluents and cooling water or runoff from the accumulation of waste. • Depending on the type of treatment,	• Laboratory analysis of liquid effluent should include a review of appropriate chemicals (depending on production), TOS, BOD, COD, pH and temperature monitoring on site.

	production of high density of BOD, COD, pH and dissolved salts	<u>For all plants</u> • Do not allow water cooling. If recycling is not feasible watch, reject water cooling so that the elevation of the temperature of the outlet does not exceed 3°C. • Maintain pH level of effluent discharge between 6.0 and 9.0. • Check the effluent limitations as prescribed by the Bank or from other standards that apply to specific processes. <u>Areas of treatment, storage and disposal of</u> • Prevent rain water does come, excessively, seep through the heap. • Proceed with coating storage areas to collect rainwater.
6	Particulate emissions produced by all plant operations.	• Check the particles by installing scrubbers, fabric filter collectors or electrostatic precipitators.
7	SOx, NOx, and CO in the atmosphere and other chemicals from chemical processing activities.	• Use water scrubbing when using alkaline solutions, by incineration or by absorption using catalytic means method.
8	Accidental release of acid or alkaline substances and solvents, potentially dangerous.	• Ensure maintenance of storage areas and drainage to prevent spillage. • Provide materials to mitigate spills. • Provide diked areas or double wall tanks.
9	Accidental releases of dangerous radiation and biological products (pharmaceuticals).	• Ensure maintenance of approved storage and disposal in order to reduce the risk of releases.
10	Noise emissions.	• Reduce the impact of noise by enclosing or noisy acoustic processing units or equipment facilities or by using other noise abatement procedures.
11	Surface runoff from chemicals, raw materials, intermediate and end products from solid waste typically stored in piles on the site could pollute surface water and seep into groundwater.	• It is possible to control infiltration and runoff of rainwater that seeps through solid materials, fuels and waste piled up by covering them or confining them to prevent pollution of surface water and basement. • It is important that diked areas are of sufficient size to contain an average rainfall of 24 hours. • Collect and exercise monitoring stormwater before it is discharged.

Indirects Impacts		
12	• Impact on the health of workers exposed to fugitive dust due to materials handling, noise or other reasons related to processing operations. • Abnormal frequency of accidents due to the skill level of the workforce.	• Should that plant managers implement a program of health and safety designed to: • identify, assess, monitor and fight against the health risks; • provide training in safety.
13	Regional problem of solid waste management exacerbated by a storage system on inappropriate places or lack of final disposal facility.	• Provide appropriate exhaust on site areas from the principle that we know to classify hazardous characteristics of the leachate. • Establish, according to a design developed in phases, appropriate facilities elimination.
14	Disruption of transit circuits, noise emissions and increased traffic, increased risk of accidents to pedestrians entails the comings and goings of trucks carrying raw materials.	• The choice of location can alleviate a number of these problems. • There should prepare sector studies at the feasibility transportation that would determine the safest routes. • Provide transport regulations and accidents in order to reduce the risk of accidents and response plan.

Alternatives to projects

Choosing a location

20. General issues which should be considered when it comes to locate an industrial establishment are discussed in the section entitled "Placement of plants and development of land for industrial purposes." The nature of a chemical plant is such that the effects on the environment, due to the activities of production, storage and transport require it pays particular attention to the evaluation of alternative sites. In addition to the considerations with regard to emissions and effluents must also pay attention to the issue of transportation of raw materials and finished products. Toxic or highly flammable substances are often involved and may pose specific transport problems, particularly in the case of petrochemical industries. Emissions are likely to affect the ecology of the environment or the surrounding inhabited areas, villages and cities. It would be important that the transport avoids areas of high population density.

Manufacturing Processes

21. Chemical industries rely on manufacturing equipment and storage extremely diverse. Should, at the design stage, to give special care to other processes. The choice of the electrolysis process chlorine or alkali is an example. Older methods are based on electrolytic cells mercury and pose risks to the environment, due to the presence of mercury in wastewater. Other methods are now available, such as processes diaphragm (the presence of asbestos in the cells is less risk) or membrane does not use mercury.

Fight against pollution

22. Equipment against air pollution and effluent control are now available for most waste streams both gas and liquid. The equipment for the fight against air pollution consists of gas scrubbers, separation membranes, cyclones, electrostatic precipitators, fabric filters, catalysts reduction or oxidation, incinerators and devices absorption.

23. You can control the wastewater effluent by using operations of neutralization, evaporation, ventilation, grinding, flotation, filtration, oil separation, carbon absorption, ion exchange, reverse osmosis, biological treatment and spreading of produced water on the land.

Management and Training

24. Chemical and petrochemical industries that could compromise the quality of air, water and soil, institutional support to achieve and monitor the handling of substances and measurements of pollution control and waste reduction are essential. Staff should be aware of the technologies used to fight against pollution of water and air. Manufacturers are generally willing to provide training sessions explaining how to operate and maintain the equipment. The standard operating procedures should be established and implemented by the factory management. Means of pollution control and monitoring of air quality and water should be included as well as instructions for the operating personnel of the company explaining the ways to control noxious emissions; guidelines alerting authorities of an accidental discharge of pollutants should also be implemented. Detectors, alarm devices, for example, and a special training at the operating personnel should improve the handling and management of toxic and hazardous substances.

25. It is essential to provide emergency measures and rapid response to incidents such as a spill, fire or explosion, the consequences for the environment and the surrounding community are extremely dangerous. To the extent that the local government officials as well as local agencies and services (medical and firefighters, etc..) Play a crucial role in this type of intervention; it would be appropriate to participate in planning process. Periodic evacuation drills are important aspects of response plans (see "Managing Industrial Risk" for further details).

26. Regulations on health and safety should be developed and implemented in the plant. These regulations should include:
    - Provisions to, on the one hand, to stop the accidental release of gas or chemical spill liquids on the other hand, respond to incidents.
    - Procedures to maintain the levels of exposure to chemical vapors below accepted standards (see Manual chemical risk management published by the National Institute of health and safety at work [National Institute for Occupational Safety and Health]).
    - A program of routine medical visits for staff handling, storage, processing or transport of hazardous chemicals.
    - A continuous training program on issues of health and safety and the maintenance of environmental friendly practices.
    - Emergency measures (accompanied by regular exercise) to ensure an action plan in the event of a serious incident of a spill, leak, explosion or fire.

27. Standards for emissions and effluents is applied to the plant should be based on national regulations, if they exist, or be derived from the standards recommended by the BOAD. Government agencies responsible for performing monitoring of pollution control equipment, enforce standards and supervise all activities related to hazardous waste destruction are likely to require specialized training, and they should also receive the necessary equipment and be vested with power. The environmental assessment should take into account an estimate of local capacity in relation to these issues and recommend ways to contribute to the project.

Monitoring

28. Due to the wide variety of chemicals and transformation means available, it is impossible to list all the chemicals that we should exercise control. A continuous reading determining the state of environmental monitoring should not only be maintained and reviewed periodically but also allow for measures of rectification. In addition to the monitoring programs required and specific plant control, location and processing methods, it would also be important to establish the following:
    - Continuous monitoring of flue gas used to supply boilers and furnaces to control the emissions of carbon monoxide as well as air and excess opacity.
    - Periodic monitoring (and sometimes still in critical situations) greenhouse gas and particulate monitoring the chemicals used or generated in the manufacturing process. (The substances which are used in the petrochemical industry comprise hydrocarbons, chlorine [containing compounds], hydrogen, oxygen-containing organic compounds and compounds containing nitrogen and sulfur.)
    - Periodic inspection (and sometimes continuously in critical situations) of all wastewater discharges including cooling water used for the compounds mentioned in the preceding paragraph.
    - Measures chosen for manufacturing processes so as to control the parameters appropriate use of pollution control equipment (measured, for example, the temperature of the flue gas as a means to verify the proper operation of washers).
    - Continuous monitoring of the quality of ambient air in the workplace by analyzing all of the compounds used in the manufacturing processes. (You can, at once, measure several compounds in combination satisfactorily: it is possible, for example, to establish the level of all organic compounds or groups of compounds containing, for example, chlorine).
    - Monitoring the quality of ambient air around the plant by monitoring priority pollutants, especially toxic and hazardous chemicals and involving alarms and remote sensors.

- Measure the discharge of storm water from the plant and storage facilities by monitoring critical pollutants, pH and suspended solids content.
- Monitoring the quality of receiving waters, seeking the presence of dissolved oxygen and critical pollutants.
- Periodic inspection of the quality of groundwater to detect phenomena of pollution caused by the manufacturing process or from storage areas.
- Analysis of the effects caused by the practices of solid waste management on the water surface and groundwater.
- Monitor all work areas by analyzing the ambient noise levels.
- Monitoring compliance with security measures and procedures for pollution control, their updating and upgrading of security plans and emergency services.
- Review of the receiving water monitoring their pH, the presence of suspended solids, and control of particles in the atmosphere.