STEEL INDUSTRY

1. The steel industry relates to a complex set of transformations where iron ore is converted into steel using coke and lime. The conversion process involves the following steps :
   (a) producing coke from coal and recovery products,
   (b) ore preparation (eg, sintering and pelletizing.) ,
   (c) production iron ,
   (d) steel production ,
   (e) casting, rolling and finishing .

Environmental impacts

2. The steel industry is one of the basic industries of developed and developing countries and it is for them an essential part of the whole industry. The economic role it plays as an employer and provider of basic products for a variety of industries is of any importance, whether buildings, machinery and equipment, production transportation and rail networks.

3. The manufacturing process of iron and steel generates large quantities of wastewater and air emissions. Poorly managed operations may give rise to serious problems of soil degradation, water and air (see table at end of section 10.14 for further details) . A brief description of the waste generated by the steel industry is provided in the following passages.

Coke production and recovery of by- products

4. The production of coke is produced by heating the fat coal to evaporate volatile compounds. Then coke as a reducing agent for the conversion of iron ore into metal in the blast furnace. A certain amount of carbon which gives rise coke in the iron dissolves in the liquid state. During cooking, large amounts of gases containing carbon monoxide occur which, in turn, give rise to a set of chemicals: coal tar , crude light oil (containing benzene, toluene and xylem), ammonia , naphthalene and major releases water vapor . Can be recovered and refined most of these chemical substances , is used for the remaining gas from the combustion of coke as the internal heating means , so that the surplus of gas can be employed in the generation of energy or as raw material for the production of chemicals.

5. Coke production generates large amounts of wastewater containing ammonia and other elements. These waters contain concentrations of phenols, cyanide, thiocyanate, ammonia, chloride and sulfide which may be toxic. Emissions from the manufacture of coke include visible fumes of smoke, dust and coke most volatile substances just mentioned.

Ore preparation

6. Minerals containing iron (hematite, limonite, magnetite) are crushed, graded and agglomerated by a sintering process of pelletizing, in nodules and pellets producing a concentrated and preconditioned ore for blast furnaces. Ore preparation can cause huge amounts of residues and give rise to dust emissions and sulfur dioxide.

Iron production

7. Iron in blast furnaces is produced by converting the ore into molten iron by reduction with coke and separating unwanted elements such as phosphorus, sulfur and manganese by adding limestone. The gases produced by blast furnaces contain carbon monoxide and are important source of particulate emissions. The slag formed from the reaction of limestone in contact with other compounds and silicates in the ore. The operation of the slag soak in water may lead to emissions of carbon monoxide and hydrogen sulfide. Liquid waste generated by the production of iron caused by sewage gas fireplace and soaking slag operations. Suspended solids in these waters are generally abundant and are likely to contain many different organic compounds (phenols and cresols), ammonia, compounds of arsenic and sulphides.

Steelmaking

8. The product in the blast furnace iron is refined in steel foundry where most of the carbon is extracted from the liquid iron. If the old mills still have hearth furnaces, the most popular method that is used in modern facilities, is to dissolve carbon in molten iron and flame the contamination with oxygen from ovens conventional oxygen. Both methods produce vast quantities of hot residual gases containing carbon monoxide and dust. You can recycle these gases once they have been dusted.

Casting, rolling and finishing

9. The final steps of the steel fabrication include cast ingots or billets according to the final product desired. The ingots are rolled plates, son, sheets, plates, bars, pipes and rods. The rolling process uses large amounts

of lubricating and hydraulic oils. Stripping Activities (remove oxide deposits) and cleaning of the final product to get rid of oils and fats may generate large amounts of acids, alkalis and liquid solvents. Modern industries often spend cast ingots, liquid steel is cast and rolled continuously.

DRI mini mills

10. An integrated mini mill consists of a reduction furnace and an electric arc furnace for producing a continuous casting of billets. Reducing the iron ore by using thus obtained natural gas (or oil -based products) in a reformed gas oven converts a gas containing hydrogen. Sponge iron obtained from the reduction process feeds the electric arc furnace which is used for conversion of steel metal. Often this type of furnace, in addition to the sponge iron, makes use of large amounts of scrap. While this method of manufacture may result in significant emissions of dust and carbon monoxide, the fact remains that it is cleaner than conventional blast furnace process solution in the since it does not use coke and it uses iron ore of high quality.

Specific issues

Solid waste

11. The mills produce a wide range of solid waste such as slag from blast furnaces that can be used in the production of quality cement, if they were properly granulated. A solid waste such as slag, that are formed when iron ore with a high phosphorus content is used, can be used as fertilizer.

12. Dust collectors for coke and sinter plants as well as blast furnaces generate waste products that can in principle partially recycled. The project design should maximize the recycling of solid waste recovered thickeners, ponds clogging of the cyclone dust separators, electrostatic precipitators and waste from storage areas for raw materials. Should the project plan emerges measures, carefully evaluated during the feasibility studies of the project, which would solve the problem of solid waste disposal. It should test the sensitivity of these waste leaching, coat the areas of disposal of solid waste and finally, to ensure constant monitoring of groundwater (see the Guidelines "Management of Industrial Risks").

Liquid waste

13. Solvents and acids that are used for cleaning steel are potentially hazardous substances and should be handled, stored and disposed of accordingly. A number of products it is important to recover may be hazardous or carcinogenic agents should, therefore, take appropriate measures for the collection, storage and disposal of these substances. It is also required to conduct monitoring of discharges of liquid and gas leaks.

Waste minimization

14. Air pollution can be a serious problem if the necessary measures were not taken. It will be important during the design phase, to examine ways to reduce pollution by means of specialized equipment for the removal of dry dust, the cleaning of exhaust gases, recovering useful chemicals and eliminating toxic pollutants, it will think of a material that captures the gas

containing carbon monoxide and hydrogen which could be used as secondary fuels or as a basis for the production of other chemicals (eg. methanol and ammonia). Such measures contribute to reducing air pollution and increase energy efficiency. Chemicals such as sulfur dioxide, nitrogen oxide, benzene, toluene, xylem, naphthalene, phenols, benzopyrene, cyanide, hydrogen sulphide and lead compounds and zinc are atmospheric pollution elements.

15. The steel industry consumes large volumes of water systems and sewage treatment are essential for all plants used in the manufacture of iron and steel should also consider the recycling of wastewater and treated . Wastewater used in the purification of gas with high solids content, it is necessary also to use major facilities coagulation and sedimentation.

16. Guidelines on the environment of the West African Development Bank prescribe emission standards while the EPA (U.S. Environmental Protection Agency) regulates standards for air quality and wastewater discharges. The steel projects in developing countries can refer to these regulations. The use of double wall tanks or containment could be part of the appropriate methods for storage of liquid in the same way that it would be necessary to install devices to detect liquid or gaseous leaks from tanks and pipes (further details are provided in the "Management of industrial risks" Guidelines).

Alternatives to projects

Choosing a location

17. General issues which should be considered when it comes to implementing an industry are discussed in the section entitled "Placement of plants and development of land for industrial purposes." The nature of a steel plant is such that the effects on the environment, which are responsible for the activities of production, storage and transport, require that one pays attention to the evaluation of alternative sites. The environmental consequences can be very serious if it is not given enough importance during the planning phase, the problems posed by waste and emissions. Outfalls that water quality is unsatisfactory or whose flow does not receive well-treated effluents are not shown.

18. The transportation of raw materials and transport finished products is another aspect that must be addressed subjects. The installation of plants in the vicinity of residential areas, especially if they are densely populated , is a solution to avoid, because of the problems of dust and noise to which they give birth. The steel industry is an industry that requires extensive planning, it is necessary that the choice of location is determined accordingly. It would, moreover, seek to ensure the future expansion of facilities.

Processes

19. While the planning and implementation of a project has many possibilities. In practice, the choice for a steel project are driven by the mineral , chemical and physical properties of raw materials available, such as iron ore , used the method of reduction in blast furnaces (eg. Coke having

undergone injections natural gas, thin oil or coal) and the fuel used to power furnaces, boilers and power plants. The choice of final products also influences the design of the plant. The mini- mills equipped with a direct reduction process of iron ore and an electro- furnace operating from natural gas and electricity will be much less harmful to the environment. The recent creation of integrated steel industries indicate that the intermediate processes of cooling and heating are less necessary - an important element in saving energy and reducing air pollution and the water.

20. There is a wide variety of resources and materials available that fight against pollution. The size and composition of pollutants to be recovered or discharged into the environment will depend on the choice of method and control equipment.

Means to fight against air pollution:

- electrostatic precipitators
- types of cyclones
- Appropriate agglomeration of fine
- Gas cooling , venturi scrubbers and separators
- flue gas scrubbers
- recovery equipment ammonia , benzene and hydrogen sulfide
- material recovery of sulfur dioxide
- baghouse
- recovery and recycling of carbon monoxide
- recovery of waste heat

Means for controlling the quality of water:

- neutralization of waste streams containing acids and alkalis
- sedimentation and flocculation units thickeners
- filtration of suspended solids remaining
- separating oil and water
- control of organic content by treating activated carbon
- control of metals by ion exchange
- control of metals by reverse osmosis
- reuse and recycling of water by evaporation or waste heat

Management and Training

21. Strategies for effective management of the fight against pollution and waste reduction may need institutional support in order to alleviate the maximum potential adverse effects of projects in steel industry on air quality and water. An engineer trained in the fight against pollution of water and air and knowing control technologies in use should be part of the team of plant personnel. Manufacturers are generally willing to provide training sessions explaining how to operate and maintain the equipment, if a request was made to them. Standard operating and planned maintenance procedures should be established and implemented by the factory management. They should also include pollution control equipment, procedures for monitoring air and water as well as instructions for notice and closure of the facility or other precautions to cope with equipment defective clearance.

22. Regulations on health and safety should be developed and implemented in the plant. In addition to the usual rules, they should include:

- Provisions to stop and deal with releases of hazardous gases (eg . Carbon monoxide and ammonia) in confined spaces and dumping of toxic liquids (eg . Sulfuric acid).
- Provisions to limit the risks of exposure to noise and excessive heat which are responsible for the heavy equipment needed to produce steel as possible.
- A program of routine medical visits.
- A continuous training program on issues of health and safety aspects and on maintenance practices environmentally.
- An action plan including emergency procedures through regular training exercises to respond to a spill, explosion or fire.

23. Standards for emissions and effluents is applied to the plant should be based on national regulations where they exist or be established from the standards recommended by the Bank. Government agencies responsible for performing monitoring of pollution control equipment , the quality of air and water, enforce standards and to supervise the activities of waste disposal should have at their disposal equipment necessary and can be invested . Specialized training may also be required. 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.

Management and tracking

24. Monitoring plans of the plant and location are required and include, in principle, the following:
    - emissions of particulates , sulfur dioxide, carbon monoxide, ammonia, hydrogen cyanide and arsenic sulfide ;

- parameters that establishing manufacturing methods involve equipment adequate pollution reduction ;
- quality of combustion and smoke opacity (produced by the boiler and power plant) ;
- air quality of the workplace that applies to the type of plant and the processes used for particulate matter, sulfur dioxide and nitrogen oxides;
- air quality downwind nearby facilities monitoring pollutants and particles;
- quality of receiving waters by monitoring dissolved oxygen , pH, potential pollutants and suspended solids;
- wastewater stream emitted by the facilities and sedimentation tanks by controlling suspended solids , pH, potential pollutants, BOD5, oil and grease ;
- discharge rainwater on oils and fats as well as suspended solids ;
- effects of the methods of disposal of solid waste on the surface and underground ;
- noise levels at workplaces of all facilities;
- noise levels outside the plant ;
- compliance with safety measures and pollution control .

Table : Steel industry

	Potential negative impacts	Mitigation measures
	Direct Impacts: choice of the location	
1	Establishment of a factory on or near sensitive habitats, such as mangroves, estuaries, wetlands and coral reefs.	• Install, if possible, the factory in an industrial area so as to reduce and concentrate the pressure on environmental services in the region and to facilitate the monitoring of discharges. • Involve agencies managing natural resources in the choice of location to carry out the examination of alternative solutions
2	A location of a plant along a mill stream causing degradation.	• The choice of the location should consider solutions that have on the environment as little effect as possible and which do not compromise the benefits that represents the exploitation of water bodies. • Plants that emit liquid discharges should be located near a

		watercourse which is sufficient capacity of assimilation of treated effluents.
3	Location can cause serious air pollution problems in the country	Set up the factory at a height that is greater than the topography of the region, in an area that suffers no atmospheric inversions and where the prevailing winds blow towards relatively sparsely populated areas.
4	Situation that could intensify solid waste problems faced by the community.	It would be important to assess the location from the following guidelines: • proximity to suitable discharge • size the field to predict discharge or drainage on site • accessibility to allow public or private collection services transporting solid waste to their final destination • reuse or recycling of materials to reduce the volumes of waste

Direct impacts: Plant operation

• Water pollution caused by discharges of liquid effluent, cooling water or runoff from waste piled up. • Plant: Suspended Solids (MES), oil and grease, ammonia, cyanide, benzene, naphthalene, benzopyrene, pH, lead, zinc • Disposition of stocks of materials piled: MES, pH, metal	Should be analyzed in the laboratory liquid effluents including: solids, oil and grease, ammonia , cyanide , phenol , benzene, naphthalene, benzopyrene , pH, lead, zinc and monitor the temperature locally. All types of plants • No discharge of cooling water. If recycling is not shown, they will be discharged in the condition that the temperature rise of the outlet does not exceed 3 ° C. • Maintain pH level of effluent discharge between 6.0 and 9.0. • Control effluent to restrictions set by the Bank or by other

	standards (such as the EPA 40 CFR 405-409, 432) for specific processes. Material storage areas and areas of solid waste • Avoid rainwater and runoff from leaking, excessively, through materials. • Proceed as flooring areas of open storage.
Air emissions of particles matter from all plant operations.	Check the particles by installing fabric filter collectors or electrostatic precipitators.
Emissions of SOx and CO from the production of coke and oil combustion.	• Purify the gases by making alkaline resolutions. • An analysis of raw materials, in the feasibility phase, can determine sulphur levels to develop emission control

	equipment. • Strip, recycle and reuse carbon monoxide.
Accidental spills of potentially harmful solvents, acidic and alkaline substances.	• Maintain areas used for the storage and disposal of substances to stop accidental releases. • Install equipment spill control, double-walled tanks or digging ditches around storage tanks.
Runoff of surface compounds, raw materials, coal, grésillons of coke and other substances usually stacked in the factory can be factors of pollution of surface waters and seep into groundwater.	• It is possible to control the infiltration of rainwater and runoff from solids, oil and waste piled in covering these substances with a tarpaulin or confining them to prevent the pollution of surface and underground waters. • The dyked areas should be of sufficient size to contain an average of 24 hours precipitation.

Impacts indirects	
• Risks to the health of workers caused by the manipulation of materials or manufacturing processes and exposed to fugitive dust and noise. • Accidents occurring more frequently than average due to a lack of staff or skill.	The factory should establish a program of health and safety is proposing: • identify, assess, exercise monitoring and control risks to the health and safety of workers • provide training in safety
Regional solid waste problem intensified by an intermediate storage system inadequate or lack of final discharge.	Provide on-site disposal areas on the assumption that the characteristics of hazardous leachates are known.
Disruption of transit circuits, the appearance of noise created by traffic and increase the risk of accidents to pedestrians entails the comings and goings of trucks carrying raw materials and fuels.	• The choice of location can alleviate a number of these problems. • should be conducted during the feasibility study of the project, studies on transport to determine the safest routes. • Provide transport regulations and an action plan in order to

reduce the risk of accidents.