

ENVIRONMENTAL IMPACTS OF THE OIL INDUSTRY

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Contents

1. Introduction
2. Oil and Gas Production Activities and Environmental Issues
3. Petroleum Refining Activities and Environmental Issues
- 3.1. Air Emissions
- 3.2. Water Effluents
- 3.3. Solid Wastes
4. Environmental Risks of the Oil Industry
5. Conclusions and Recommendations

Related Chapters

Glossary

Bibliography

Biographical Sketch

Summary

This chapter aims to present the main environmental impacts of the oil and gas industry throughout the stages of exploration and discovery of new deposits, hydrocarbon production and oil refining. It also addresses the issue of environmental risks in the industry and possible accidents that may arise from its activities.

1. Introduction

Oil plays a vast and vital role in our society as it is organized today. Oil represents much more than just one of the main energy sources used by mankind. Besides being an important energy source, petroleum products serve as feedstock for several consumer goods, thus playing a growing and relevant role in people's lives.

On the other hand, the oil industry holds a major potential of hazards for the environment, and may impact it at different levels: air, water, soil, and consequently all living beings on our planet. Within this context, the most widespread and dangerous consequence of oil and gas industry activities is pollution. Pollution is associated with virtually all activities throughout all stages of oil and gas production, from exploratory activities to refining. Wastewaters, gas emissions, solid waste and aerosols generated during drilling, production, refining (responsible for the most pollution) and

transportation amount to over 800 different chemicals, among which, of course, prevail oil and petroleum products.

Other environmental impacts include intensification of the greenhouse effect, acid rain, poorer water quality, groundwater contamination, among others. The oil and gas industry may also contribute to biodiversity loss as well as to the destruction of ecosystems that, in some cases, may be unique.

Most potential environmental impacts related to oil and gas industry activities are already well documented. It is still necessary to find ways to conciliate industry development with environmental protection, that is, with sustainable development.

After recovered and transported, crude oil has to go through refining processes in order to be converted into products that hold commercial value. Oil refineries are major polluters, consuming large amounts of energy and water, producing large quantities of wastewaters, releasing hazardous gases into the atmosphere and generating solid waste that are difficult both to treat and to dispose of.

On the other hand, despite its potential threats to the environment, the oil industry plays a positive role in society as well, creating many jobs and generating a significant volume of tax revenues and royalties to national governments.

Therefore, oil companies may profit even more and in different ways by adopting proactive environmental strategies. However, many companies in the oil business are still not adopting pollution prevention practices. Their environmental policies are oriented towards the compliance of rules established by environmental authorities, which reflects an *End of Line Control* corporate culture as well as a *reactive* approach to environmental management.

Taking the environmental variable into account in productive processes has been a serious and important challenge for the oil industry. Today, the commitment to promote sustainable development goes beyond ethical and moral obligations, and has become a demand from society. This commitment alone is a limiting factor to the survival of companies, since numerous consumers may be influenced by the negative image associated with companies that harm the environment.

Table 1 presents in a simplified manner the main potential environmental impacts of the oil industry, as well as some feasible alleviating measures.

Potential Environmental Impacts	Mitigation Measures
<ul style="list-style-type: none"> • Water contamination due to effluent, wash water and cooling water discharges, and seepage from storage and waste tanks; • Water contamination due to discharges of water effluents rich in inorganic salts without appropriate treatment (saline pollution) 	<ul style="list-style-type: none"> • No wastewaters shall be discharged without appropriate treatment into rivers or other locations where infiltration may occur. • Water effluents may be treated by: neutralization, evaporation, aeration, flocculation, oil and grease separation, carbon adsorption, reverse osmosis, ion

<ul style="list-style-type: none"> • Thermal pollution due to discharge of effluents with temperatures higher than recipient water bodies; • Water contamination due to oil spills; 	<p>exchange, biotreating etc., depending on the contaminant to be removed.</p> <ul style="list-style-type: none"> • Liquid effluent discharges into recipient water bodies must comply with standards governed by laws and regulations adopted in each country. • Materials that may seep due to rains must be placed in covered storage areas equipped with drainage systems, in order to avoid contamination of rain waters. • Areas for storing and handling of raw materials and products should be waterproofed and have a drainage system, so that any spills and wash waters can be directed to treatments.
<ul style="list-style-type: none"> • Particulate emissions into the atmosphere generated during operations at production and refining plants. 	<ul style="list-style-type: none"> • Particulate emissions can be controlled by equipment such as cyclones, bag filters, electrostatic precipitators and scrubbers, among others; • Acidic emissions such as sulfur and nitrogen oxides can be controlled with the use of wet scrubbers; • Dust emissions from patios and outdoor areas free from chemical contaminants can be controlled with water sprays.
<ul style="list-style-type: none"> • Sulfur and nitrogen oxides, ammonia, acid mist and fluorine compounds gas emissions from production and refining plants operations. 	<ul style="list-style-type: none"> • Gas emissions can be controlled by wet scrubbers or carbon adsorption, among other techniques.
<ul style="list-style-type: none"> • Occasional release of potentially hazardous materials, such as solvents and acid or alkaline materials. 	<ul style="list-style-type: none"> • Preventive maintenance of equipment and storage areas, to prevent occasional leaks. • Dikes and catch basins placed around or downstream from dangerous or environmentally hazardous materials storage tanks.
<ul style="list-style-type: none"> • Soil, surface water and/or groundwater contamination by inappropriate disposal of solid wastes resulting from chemical industry processes, including effluent treatment sludge and particulate matter from dust collectors. 	<ul style="list-style-type: none"> • Solid wastes that cannot be recycled must be treated appropriately before final disposal. • The choice of appropriate treatment must comply with the waste classification according to the pertinent regulation(s). • Depending on the nature of the waste, possible treatment methods include: incineration, controlled landfill disposal, chemical immobilization and solidification, encapsulation, burning in cement kilns, etc. • Should these treatments be unavailable at the site, the waste may be treated in other plants with suitable facilities, in which case special care must be taken during waste transportation.

	<ul style="list-style-type: none"> If the waste is not treated immediately after being generated, there must be suitable areas for storage at the plant site.
<ul style="list-style-type: none"> Changes in local traffic due to truck circulation (including dangerous cargos) 	<ul style="list-style-type: none"> Accessibility and road system conditions must be assessed during feasibility studies, selecting the best routes to reduce impact and risk of accidents.
<ul style="list-style-type: none"> Noise pollution caused by equipment and operations that generate loud noise. 	<ul style="list-style-type: none"> Acoustic treatments by enclosure of equipment or soundproofing buildings that hold loud equipment and/or units that operate at significant noise levels.
<ul style="list-style-type: none"> Accidents that impact the environment, such as large oil spills, leaks, fires and explosions on plants. Eventual deaths. 	<ul style="list-style-type: none"> Emergency Response Plan.

Table 1. Potential Environmental Impacts of the Oil and Gas Industry
Source: based on Banco do Nordeste, 1999.

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Biographical Sketch

Jacqueline Mariano, Chemical Engineer, M.Sc. and D.Sc. in Energy and Environmental Planning (COPPE – Federal University of Rio de Janeiro, Brazil). She has 11 years experience in the field of Energy and Environmental Planning as a researcher and as a consultant. Since 1999, she has been being heavily involved in environmental activities, pertaining especially to oil and natural gas industry related matters, including their Climate Change issues. Currently she works at the National Petroleum Agency, the Brazilian regulator authority of the sector.

Emilio Lèbre La Rovere background is on systems engineering and economics, with a M.Sc. in Systems Engineering by COPPE/UFRJ and a Ph.D. in Economics, by the School of High Studies in Social Sciences, University of Paris. He is currently Professor of the Energy Planning Program at COPPE/UFRJ, and Coordinator of the Environmental Sciences Laboratory as well as of the Center for Integrated Studies on Climate Change and the Environment, both at COPPE/UFRJ. He was the head of the department in 1995-1996 and of the M.Sc./Ph.D. Environmental Planning Course, from 1988 to 1997. Professor Emilio has also supervised Jacqueline's D.Sc. Thesis.

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