



ENVIRONMENTAL IMPACTS OF AIR SEPARATION UNITS

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Amendments to 94/17

Section	Change
4.3.3.2, 5	Added reference [4] - Directive 2006/42/EC on Machinery
Appendix 1	Deleted EIGA Document link to ISO 14001:2004

NOTE Technical changes from the previous edition are marked with a line in the left margin

1 Introduction

This publication details the environmental impacts of air separation units (ASU) and gives guidelines on how to reduce the impacts.

2 Scope and purpose

2.1 Scope

The publication concentrates on the environmental impacts of cryogenic ASUs. This publication does not give specific advice on health and safety issues, which shall be taken into account before undertaking any activity. On these issues the relevant EIGA documents, and or national legislation should be consulted for advice.

2.2 Purpose

This publication is intended to serve as a guide to assist in putting in place a formal environmental management system that can be certified by an accredited third party verifier. It also aims to provide a guide for operating managers for identifying and reducing the environmental impacts of these operations.

3 Definitions

3.1 Publications terminology

3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should

Indicates that a procedure is recommended.

3.1.2.1 May and need not

Indicate that the procedure is optional.

3.1.3 Will

Is used only to indicate the future, not a degree of requirement.

3.1.4 Can

Indicates a possibility or ability.

3.2 Technical definition

3.2.1 Environmental aspect

Elements of an organisation's activities, products or services that can interact with the environment. [1]¹
For example: use of energy or transportation of products.

3.2.2 Environmental impact

Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects. [1]

¹ References are shown by bracketed numbers and are listed in order of appearance in the reference section

For example, the contamination of water with hazardous substances or the reduction of air emissions.

4 Air Separation Unit

4.1 General environmental aspects, impacts and links to other EIGA documents

This publication covers the environmental impacts of ASUs which are summarised in Appendix 3.

There are several EIGA publications that provide more details on general environmental issues, legislation for the gas industry and good environmental operational practices e.g. EIGA Doc 88 *Good Environmental Management Practices for the Industrial Gas Industry* [2]. A list of documents and their links to the ISO 14001 environmental management systems standard is provided in Appendix 1. Appendix 1 also shows which of these documents are relevant to ASUs.

4.2 Introduction

4.2.1 Production methods

Industrial gases are generally produced as close as technically and economically possible to the customer. This helps to minimise the impacts of transportation.

Gas (in liquid or gaseous form) can be transported by pipeline, road, rail or sea. Pipeline transportation from on or off-site gas generators avoid many of the environmental impacts, though the pipeline occupies land resources and there are compression losses.

The advent of small non-cryogenic gas generators has led to an increase in the gas generated on the customer site. This avoids the environmental impacts of transporting the gas in liquid form and vaporizing it.

4.2.2 Design, planning and control

The basic philosophy is the minimisation of environmental impacts. By considering the potential wastes which a new process could generate when engineering a plant, future problems can be avoided. This environmental analysis is a crucial element of environmental impact assessment that is strongly recommended before any decision of an industrial investment.

Eliminating or minimising waste generated in ASUs is the first rule to follow; for this reason, it is necessary to stress the importance of minimisation during the stages of plant engineering and of plant operation.

Waste should not be mixed but collected separately to aid further recycling reuse or recovery.

Safety data sheets for all chemical substances should be held on site and used to determine the best way to handle the chemical substances.

4.2.3 Environmental impact of an ASU

These units have a minimal direct impact on the environment because of the inherent nature of the processes used in ASUs.

Gases produced by ASUs have a positive impact on the environment thanks to the reduction of the environmental load when replacing a non-gas process with a process using gases. There is a very high number of successful gas applications that gives the customer an improved economical result and at the same time decreased emissions, increased recycling of material, reduced consumption of energy or water, and other environmental benefits.

The production of atmospheric gases from ASUs uses one of three technologies:

- cryogenic air separation;
- adsorption in pressure swing or vacuum swing absorber (PSA/VSA) units, and
- diffusion in membrane units.

The three air separation processes have many common characteristics:

- they use air as a feedstock;
- they are physical processes - no chemical reactions are involved;
- compressors and/or blowers are used to drive the separation and provide products at pressure;
- the products are consistently high quality and contain no unwanted contaminants; and
- only materials originally present in the air could end up in the waste gas streams (purges and vents).

Cryogenic air separation is the most used and the oldest technology, and this publication therefore concentrates on the impacts of cryogenic air separation. Appendix 2 shows a typical air separation scheme and Appendix 3 a process mapping of the wastes and emissions.

4.3 Main environmental impacts of the process

4.3.1 Principal impacts

The principal impacts, either by amount or by potential consequences on the environment are:

- use of energy in the compression;
- use of water for cooling;
- use of oil;
- historical use of polychlorinated biphenyl (PCB) or other equivalent substances;
- emissions of volatile organic compounds (VOC): hydrochlorofluorocarbons (HCFC), chlorofluorocarbons (CFC), hydrofluorocarbons (HFC), chlorinated solvents during maintenance or accidentally from the chillers; and
- discharges of contaminated water;
- noise and vibration
- waste from maintenance.

4.3.2 Air intake

4.3.2.1 Air emissions

The only air emissions resulting from any of the air separation processes are air gases and impurities in the air returned to the air. In some instances, a small amount of natural gas or electricity, is used in cryogenic plants to provide heat for regenerating pre-purifiers. Very low-levels of air emissions result. However, accidental spills and releases of hazardous products could need to be reported to the authorities, depending on the national regulations.

In the case where back up vaporisation systems use fired heaters there are combustion emissions and these heaters may also need to have specific permits and monitoring, depending on national regulations.

4.3.2.2 Air filters

Air filters are likely to be contaminated by air borne pollutants. Used filters should be disposed of at authorised facilities.

4.3.3 Compression

4.3.3.1 Energy

Cryogenic air separation is an energy intensive process; to typically produce one cubic metre of liquid nitrogen or oxygen in a cryogenic air separation unit requires approximately 1 kWh/m³. While a non-cryogenic on-site unit requires less energy per unit it is not suitable for some applications as it does not produce liquid and it cannot match the purity of gas from cryogenic separation.