

# **ANNEX 4**

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## **GLOSSARY FOR INDUSTRIAL PROCESSES AND PRODUCT USE SECTOR**

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This annex provides definitions and abbreviations for terms used in this volume on Industrial Processes and Product Use (IPPU) Sector. This annex should be used in conjunction with the general 'Glossary' in Volume 1 of these Guidelines which provides definitions for terms used not only in this volume but also in the other volumes.

### **Glossary**

#### **ACETYLENE BLACK PROCESS**

Thermal decomposition process to produce carbon black from acetylene.

#### **ADIPIC ACID (HEXANEDIOIC ACID)**

A carboxylic acid primarily used in the chemical industry as an intermediate step in the production of nylon 6.6. It is commercially produced from cyclohexane by oxidation processes. The process of producing adipic acid produces nitrous oxide (N<sub>2</sub>O) as a by-product.

#### **AMMOXIDATION**

Process of conversion of olefin, paraffin, etc. to nitrile (R-CN) in the presence of ammonia (NH<sub>3</sub>) and oxygen (O<sub>2</sub>). A typical example is reaction of propylene (C<sub>3</sub>H<sub>6</sub>), ammonia and oxygen to produce acrylonitrile.

#### **ASPHALT**

Asphalt is the mixed product of bitumen and aggregates (coarse or fine including sand), used for paving roads and pavements (i.e., sidewalks), also known as macadam, for roofing and industrial uses. Main asphalt types are: Hot Mix Asphalt (HMA), liquefied asphalt, cutback asphalt, slow-cure asphalts (synonym: road oil), emulsified asphalt and mastic asphalt. Cutbacks and emulsions are typically used as prime coats and tack coats; mastic asphalt for roofing. The mixture of aggregates (coarse or fine including sand) and hot bitumen when placed on the road, compacted and subsequently cooled, becomes the familiar asphalt. Aggregates make up approximately 90-96 percent of the asphalt mixture (asphalt binder makes up the other 4-10 percent). The term 'asphalt' in the USA is informally applied both to the bitumen (crude asphalt) that is a residue of the petroleum refining process and also to the 'asphalt binder' that is produced from bitumen and the 'asphaltic concrete' that is used for road paving and other applications.

#### **ASPHALT BINDER**

Bitumen (crude asphalt) that has been prepared for use as a binder in Hot Mix Asphaltic Concrete and other paving applications. Asphalt binder is also sometimes referred to informally in the USA as 'asphalt cement'.

#### **ASPHALTIC CONCRETE**

Asphaltic concrete consists of asphalt binder (bitumen, asphalt cement) and mineral aggregate mixed together, laid down in layers and compacted. Hot Mix Asphaltic Concrete (also referred to as Hot Mix Asphalt) is a combination of approximately 95 percent mineral aggregate bound together by asphalt binder that is heated prior to mixing. Asphaltic concrete is informally referred to in the USA as 'asphalt' or 'asphalt concrete'.

#### **BANK (FOR PURPOSES OF CHAPTERS 7 AND 8)**

Banks are the total amount of substances contained in existing equipment, chemical stockpiles, foams and other products not yet released to the atmosphere. This terminology is traditionally used for substitutes for Ozone Depleting Substances and other fluorinated compounds.

#### **BASIC OXYGEN FURNACE (BOF)**

Basic oxygen furnaces are the primary means of steel manufacture from pig iron and scrap steel. Oxygen is blown into the molten charge and oxidises the carbon present in the iron (about 4 percent) reducing it to the levels required for steel (about 0.5 percent). The carbon dioxide and carbon monoxide produced are carried away

by the gas and dust collection system. The oxidation process heats the molten charge and helps melt the steel scrap added. Basic oxygen furnaces are also referred to as 'LD-converter' (or 'Linz-Donawitz converter') after the 'Linz-Donawitz' steelmaking process first developed in Austria.

### **BITUMEN**

Bitumen is a solid, semi-solid or viscous hydrocarbon with a colloidal structure, being brown to black in colour, occurring naturally or obtained as a residue in the distillation of crude oil, by vacuum distillation of oil residues from atmospheric distillation. It is a component of asphaltic concrete (typically 4 to 10 percent of the mixture) and serves to hold the aggregates (mineral matter that makes up the other part) together, generally used for construction of roads and for roofing material and in spray seal applications. Most (typically 80 to 90 percent) is used for paving of roads, typically 80 to 90 percent. Bitumen is usually stored at approximately 150°C to maintain it in a liquid form. In the USA bitumen is more commonly referred to as 'asphalt' or 'asphalt binder'.

### **BLAST FURNACE**

A furnace used in the iron and steel industry in which combustion is intensified by a blast of air, especially a furnace for smelting iron by blowing air through a hot mixture of ore, coke, and flux.

### **BLOWN ASPHALT**

Synonym for oxidised bitumen. Asphalt that has been treated by blowing hot air through it to produce physical properties required for the industrial use of the final product. Oxidised asphalts are typically used in roofing operations, pipe coating and hydraulic applications. Also known as 'air-blown asphalt' or 'air-refined asphalt'.

### **BUSHING**

A device that enables one or several electrical conductors to pass through a partition such as a wall or a tank and that insulates the conductors from it. The means of attachment (flange or fixing device) to the partition forms part of the bushing.

### **CALCINATION**

Chemical process in the manufacture of cement or lime in which the raw materials, primarily carbonates, are heated in kilns to produce a metallic oxide and carbon dioxide; e.g.,  $\text{CaCO}_3 + \text{heat} = \text{CaO} + \text{CO}_2$ . More generally, calcination is a process of heat-induced driving off of structurally-bound volatiles other than water.

### **CAPROLACTAM**

Caprolactam ( $\text{NH}(\text{CH}_2)_5\text{CO}$ ) is the monomer for nylon-6 fibres and plastics, with a substantial proportion of the fibre used in carpet manufacturing. Commercial processes for the manufacture of caprolactam are based on either toluene or benzene.

### **CARBON BLACK FEEDSTOCK**

A heavy aromatic oil that may be derived either as a by-product of the petroleum refining process or the metallurgical (coal) coke production process.

### **CARBON MASS BALANCE CALCULATION (FOR PURPOSES OF SECTION 3.9)**

A method of estimating total carbon emissions from a chemical process by identifying the mass flow rate and carbon content of each process stream flowing into the process and out of the process. The process streams to be considered include raw materials (i.e., feedstocks), supplemental fuels, primary products, secondary products, solid and liquid waste products, and exhaust gas streams (e.g., purge gas, off gas.)

### **CARBONATES**

Compounds containing the radical  $\text{CO}_3^{2-}$ . Upon calcination, the carbonate radical decomposes to evolve carbon dioxide ( $\text{CO}_2$ ). Common carbonates consumed in the mineral industry include calcium carbonate ( $\text{CaCO}_3$ ) or calcite; magnesium carbonate ( $\text{MgCO}_3$ ) or magnesite; and calcium-magnesium carbonate ( $\text{CaMg}(\text{CO}_3)_2$ ) or dolomite.

## **CATALYST**

A substance that accelerates the rate of a chemical reaction, but is not consumed as raw material and does not become a chemical product of the reaction.

## **CATALYST SELECTIVITY**

The percentage of the primary feedstock to the catalytic reaction process that is converted into the primary product of the process.

## **CATALYTIC INCINERATION**

Oxidation of organic compounds to CO<sub>2</sub> and H<sub>2</sub>O using a metal catalyst in a low temperature reaction. Catalytic incineration occurs at a lower temperature than thermal incineration.

## **CATALYTIC OXIDATION**

Generally referred to oxidation of feedstock (e.g., natural gas) to CO<sub>2</sub> and H<sub>2</sub>O using a catalyst.

## **CEMENT KILN DUST (CKD)**

Non-calcined to fully calcined dust produced in the kiln or pyroprocessing line. CKD may be partly or completely recycled to the kiln.

## **CENTERLINE PROCESS**

Centerline process refers to the nominal values of process variables that govern the performance specifications of commercial-ready manufacturing equipment. These are the nominal values for gas flows, chamber pressure, plasma power, etc. It is common for semiconductor device manufacturers to modify these conditions to optimize for particular requirements.

## **CIRCUIT BREAKER**

A mechanical switching device, capable of making, carrying and breaking current under normal circuit conditions and also making, carrying for a specified time and breaking current specified abnormal circuit conditions such as those of a short circuit.

## **CLINKER**

An intermediate product created at high temperature in a kiln during the manufacture of cement. In the kiln, calcium carbonate is calcined to lime (CaO) and carbon dioxide (CO<sub>2</sub>). The CaO then reacts with silicon dioxide (SiO<sub>2</sub>) and other oxides to form hydraulically reactive minerals (primarily calcium silicates) within semivitrified nodules called clinker. The clinker is then finely ground (typically with a small quantity of gypsum) to form cement. The CO<sub>2</sub> (both from calcination and from the combustion of kiln fuels) from clinker manufacture is normally released to the atmosphere as a waste product and is a significant global source of CO<sub>2</sub> emissions.

## **CLOSED-PRESSURE SYSTEM**

Electrical equipment that requires periodic refilling (topping up) with gas during its lifetime. This type of equipment generally contains between five and several hundred kilograms per functional unit. Transmission equipment normally falls into this category. In the latest IEC standards, the tightness of new closed pressure systems is specified by the relative leak rate of each compartment; standardized values for SF<sub>6</sub> are 0.5 percent and 1 percent per year. However, older closed pressure systems in the field may have significantly higher leak rates.

## **COAL TAR**

Liquid by-product formed from the distillation of bituminous coal to make coke. It is a viscous black liquid containing numerous organic compounds. Coal tar can be further distilled to give various aromatic compounds (distillates) and coal tar pitch (carbon pitch). Coal tar products are used as roofing, waterproofing, and insulating compounds and as raw materials for many dyes, drugs, and paints.

## **COKE OVEN GAS**

Obtained as a by-product of solid fuel carbonisation and gasification operations carried out by coke producers and iron and steel plants which are not connected with gasworks and municipal gas plants.

## **COMBINED REFORMING**

A combination of the conventional reforming process and catalytic oxidation reaction to produce methanol.

## **CONVENTIONAL REFORMING**

A combination of the steam reforming reaction to produce synthesis gas and the methanol-synthesis gas reaction to produce methanol.

## **DESTRUCTION**

In the case of a fluorinated greenhouse gas, 'destruction' means the process by which all or most of the compound is permanently transformed or decomposed into one or more stable substances which are not fluorinated greenhouse gases.

## **DESTRUCTION OR REMOVAL EFFICIENCY (DRE)**

Destruction or Removal Efficiency (DRE) means the efficiency, expressed as a decimal fraction (on a carbon or CO<sub>2</sub> equivalent basis), of a control device to destroy or remove all relevant contaminants. The DRE is equal to one minus the ratio of the amount of all relevant contaminants exiting the emission control device to the amount of all relevant contaminants entering the emission control device. Relevant contaminants mean any greenhouse gases covered by these Guidelines (see Volume 1, Chapter 8), including those formed during the destruction process.

## **DIRECT CHLORINATION**

Direct reaction of a compound to produce substituted chlorinated compounds, e.g., ethylene (C<sub>2</sub>H<sub>4</sub>) with chlorine (Cl<sub>2</sub>) to produce ethylene dichloride.

## **DIRECT REDUCED IRON**

Also referred to as 'sponge iron'; a metallic iron product obtained upon direct reduction of high grade iron ore pellets below the melting point of iron. The iron is reduced in the solid state without being converted into liquid form, as in a blast furnace.

## **DISPOSAL EMISSIONS (FOR PURPOSES OF CHAPTER 8)**

The emissions of fluorinated greenhouse gases that occur during the disposal or decommissioning of equipment. For the Tier 2 method (Equation 8.2), Disposal Emissions are defined to include emissions associated with the recovery of the gas, the recycling of the gas, and the destruction of the gas that is not recycled. For the Tier 3 method (Equations 8.7A and 8.7B), Disposal Emissions are defined to include emissions associated with the recovery of the gas. (Emissions associated with recycling and destruction are accounted for in separate Tier 3 equations.) Disposal emissions as defined for both Tiers are sensitive to the fraction of retiring equipment whose charge is recovered (Recovery Frequency) and to the fraction of the remaining charge that is recovered when recovery is performed (Recovery Efficiency).

## **ELECTRIC ARC FURNACES (EAF)**

The principal batch furnace type for the electric production of steel. The primary application of the EAF is for the remelting of steel scrap. However, EAFs can be charged with limited amounts of iron scrap, pig iron, and direct reduced iron. Heat is supplied from electricity that arcs from the graphite electrodes to the metal bath. The electrodes are usually made from graphite or from Soderberg (carbon) paste. EAFs are also used for other metallurgical applications, such as the production of ferroalloys and similar (silicon carbide).

## **ELECTRICAL EQUIPMENT**

Any item used for such purposes as generation, conversion, transmission, distribution or utilisation of electric energy, such as machines, transformers, apparatus, measuring instruments, protective devices and wiring systems. Most of the sulphur hexafluoride (SF<sub>6</sub>) used in electrical equipment is used in gas-insulated switchgear and substations (GIS) and in gas circuit breakers (GCB), though some SF<sub>6</sub> is used in high voltage gas-insulated lines (GIL), outdoor gas-insulated instrument transformers and other equipment. In addition, perfluorocarbons (PFCs) are used in power transformers in some regions.

## **ELECTRICAL EQUIPMENT FAILURE**

A major or catastrophic failure of electrical equipment (in any function but gas containment itself) that results in the cracking or burning of one or more holes in a gas compartment and that therefore leads to the release of the charge in that compartment.

## **EMISSION RATE**

The emissions during a process, lifecycle stage, and/or defined period of time (usually a year), divided by the relevant activity data for that process or lifecycle stage, such as the total consumption of chemical for manufacturing or the Nameplate Capacity of the equipment for use. The preferred unit is percent per year.

## **EQUIPMENT COUNT**

An inventory of individual plant equipment (e.g., valves, flanges) that is used in implementing a leak detection program.

## **ETHANE**

A naturally occurring saturated hydrocarbon (C<sub>2</sub>H<sub>6</sub>) extracted from natural gas and refinery gas streams. It is mainly used in the production of ethylene by steam cracking.

## **EXOTHERMIC**

Chemical reaction where the energy content of the products is less than that of the reactants; heat is given out from the system.

## **FACTORY FILLING EMISSIONS**

Initial Charging Emissions that occur at the factory.

## **FERROALLOY**

Ferroalloy is the term used to describe concentrated alloys of iron and one or more metals such as silicon, manganese, chromium, molybdenum, vanadium and tungsten. Silicon metal production is usually included in the ferroalloy group because the silicon metal production process is similar to the ferrosilicon process. These alloys are used for deoxidising and altering the material properties of steel.

## **FINAL USE EMISSIONS**

The emissions that occur between the last refill of the equipment and its disposal. These may be a significant share of total emissions, particularly if the equipment has a low leak rate and is refilled infrequently.

## **FLARE**

Device to combust volatile organic compounds in exhaust gas streams without energy recovery.

## **FLUORINATED COMPOUNDS (FCs)**

Fluorinated compounds (FCs) is a term used in Chapter 6, 'Electronics Industry Emissions', to account for the broad range of high- and low (or zero)-GWP fluorinated gases and liquids used during electronics manufacturing. FCs include certain perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) as well as sulphur hexafluoride (SF<sub>6</sub>). Low (or zero)-GWP chemicals, such as CH<sub>2</sub>F<sub>2</sub>, COF<sub>2</sub> and F<sub>2</sub>, are included when their use leads to the formation of high-GWP products such as CF<sub>4</sub>.

## **FURNACE BLACK**

A type of carbon that is produced industrially in a furnace by incomplete combustion in an adjustable and controllable process that yields a wide variety of properties within the product (IUPAC).

## **FURNACE BLACK PROCESS**

Pyrolysis process to produce carbon black from carbon black feedstock and natural gas.

**GAS-INSULATED LINES**

Metal-enclosed lines for electricity transmission and distribution in which the insulation is obtained, at least partly, by an insulating gas other than air at atmospheric pressure, with the external enclosure intended to be electrically grounded.

**HOT BRIQUETTED IRON**

Direct reduced iron converted into briquettes, generally to facilitate the transportation of the material.

**HYBRID LIFE-CYCLE APPROACH**

The Tier 3 method for estimating emissions from electrical equipment. This method estimates emissions by lifecycle stage using an emission-factor approach, a mass-balance approach, or a combination of the two, as appropriate given data availability and country- and process-specific circumstances.

**INCOMPLETE COMBUSTION.**

Combustion of organic compounds in which the combustion results in less than 100 percent conversion of the organic compounds to CO<sub>2</sub> and H<sub>2</sub>O. This may be due to a lack of oxygen or low temperature, preventing the complete chemical reaction. Carbon monoxide is produced as a by-product due to incomplete combustion.

**INITIAL CHARGING OR FILLING EMISSIONS**

The emissions that occur during the initial filling of the equipment either in the factory or at the site where the equipment is to be used, as applicable.

**INSTALLATION EMISSIONS**

Initial Charging Emissions that occur at the site where the equipment is to be used before the equipment is commissioned for operation.

**INSTRUMENT TRANSFORMER**

A transformer intended to supply measuring instruments, meters, relays and other similar apparatus by converting the original system values for voltage and current into a replica suitable for data processing.

**LEAKAGE**

The emissions from a piece or type of equipment during operation under normal operating conditions, excluding emissions from maintenance, service and electrical equipment failures.

**LEAK DETECTION PROGRAM**

A program to directly measure emissions from fugitive emissions sources (e.g., valves, flanges) by measuring emissions from individual plant equipment.

**LEAK RATE**

The Leakage from a piece or type of equipment over a given period of time, usually a year, divided by the Nameplate Capacity of the equipment. The preferred unit is percent per year.

**LIME KILN DUST (LKD)**

Non-calcined to fully calcined dust produced in a lime kiln line. It is analogous to CKD, although LKD is only rarely recycled to the lime kiln. LKD can be used as a raw material in a cement kiln.

**LOSS RATE**

Emission Rate.

**MANUFACTURING EMISSIONS**

Emissions occurring on the premises and under the responsibility of the equipment manufacturer, including emissions from research and development, testing, and filling of equipment with operating or holding charges.

**MASS-BALANCE APPROACH (FOR PURPOSES OF CHAPTERS 7 AND 8)**

A method for estimating emissions of fluorinated greenhouse gases from use in equipment that can be applied to individual units and to aggregates of units (for example by country, application or facility). In this approach, annual emissions are the difference between the quantity of gas consumed in the year and the quantity of gas used to fill the net increase in equipment capacity or to replace destroyed gas.

**METALLURGICAL COKE**

Synonym for coke-oven coke. Coke, a high carbon fuel and/or reductant made by high temperature devolatilisation (carbonisation) of certain grades of bituminous coal, is a porous fuel with few impurities and high carbon content, mainly used in metallurgical processes such as in the blast furnace to make iron and in the manufacture of ferro-alloys, lead, and zinc. Semi-coke, the solid product obtained from carbonisation of coal at low temperature, is included with coke-oven coke and is used mainly as a domestic fuel. Not to be confused with petroleum coke.

**METERED DOSE INHALERS (MDIs) (MEDICAL AEROSOLS)**

A method of dispensing inhaled pulmonary drugs.

**METHANOL**

Also known as methyl alcohol, used especially as solvent, antifreeze, or denaturant. It is also used in the synthesis of other chemicals. Methanol produced from natural gas should be included with refinery feedstock figures.

**MINERAL PITCH**

Residue of petroleum distillation. See 'Asphalt'.

**NAMEPLATE CAPACITY**

The full and proper charge of fluid/gas specified by the equipment manufacturer to achieve the equipment's specified performance. The nameplate capacity is typically indicated on the equipment's nameplate; it is not necessarily the actual charge, which may be influenced by leakage and other emissions. This definition is relevant to chapters 1, 6, 7 and 8 of this volume.

**NITRIC ACID**

A strong acid used mainly as feedstock in fertiliser production and in the production of adipic acid. The production of nitric acid produces nitrous oxide (N<sub>2</sub>O) as an unintended by-product.

**OLEFINS**

Synonym for alkenes. Class of hydrocarbons with an open chain containing one or more double bonds. This group of hydrocarbons has the general formula C<sub>n</sub>H<sub>2n</sub>. Olefins are named after the corresponding paraffins by the addition of 'ene' or 'ylene' to the stem (e.g., polyethylene and polypropylene). The simplest olefin is ethylene, C<sub>2</sub>H<sub>4</sub>.

**OPEN HEARTH FURNACE**

The open hearth furnace, also known as the reverberatory furnace, consists of a wide, saucer-shaped refractory-lined hearth with a low roof. Pig iron, limestone, and scrap are charged into the hearth and heated by overhead burners using preheated air, after which the furnace is charged with molten pig iron, which is further heated to produce steel. The burners are generally gas-fired.

**OXIDISED DURING USE FACTOR (ODU FACTOR)**

A factor that represents the fraction of fossil fuel carbon that is oxidised during the use of non-energy products of fossil fuels.

**OXYCHLORINATION**

Reaction of ethylene (C<sub>2</sub>H<sub>4</sub>) with hydrochloric acid (HCl) and oxygen (O<sub>2</sub>) to produce ethylene dichloride and water (H<sub>2</sub>O).

## **OXYGEN STEEL FURNACE GAS**

Obtained as a by-product of the production of steel in an oxygen furnace (or basic oxygen furnace): it is recovered on leaving the furnace. The gas is also known as converter gas or LD gas. Data should correspond to the quantity of gas used for the production of electricity or in cases where waste heat is recovered from the gas and sold to third parties. Quantities of this gas should be included with Blast Furnace Gas.

## **OZONE-DEPLETING SUBSTANCES (ODS)**

Substances known to deplete the stratospheric ozone layer. The ODSs controlled under the Montreal Protocol and its amendments are chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide (CH<sub>3</sub>Br), carbon tetrachloride (CCl<sub>4</sub>), methyl chloroform (CH<sub>3</sub>CCl<sub>3</sub>), hydrobromofluorocarbons (HBFCs), and bromochloromethane.

## **PARAFFINS**

Synonym for alkanes. The name paraffin often refers specifically to alkane molecules (isomers) having long straight chains. See also 'Paraffin waxes'.

## **PARAFFIN WAXES**

Synonym for alkanes and paraffins. The name paraffin often refers specifically to alkane molecules (isomers) having long straight chains. These are saturated aliphatic hydrocarbons. These waxes are residues extracted when dewaxing lubricant oils. They have a crystalline structure which is more-or-less fine according to the grade. Their main characteristics are as follows: they are colourless, odourless and translucent, with a melting point above 45°C.

## **PETROLEUM COKE (PETCOKE)**

A shiny, black solid residue that is the final product of the condensation process in oil cracking and carbonisation in furnaces. It consists mainly of carbon (90 to 95 percent) and generally burns without leaving any ash. It is used mainly in metallurgical processes and as a fuel in cement manufacture. The term excludes those solid residues (metallurgical coke) obtained from carbonisation of coal. Sometimes one distinguishes between marketable coke or catalyst coke. Marketable coke is those grades of petroleum coke produced in delayed or fluid cokers that may be converted as relatively pure carbon. This 'green' coke may be sold as is or further purified by calcining. Catalyst coke is generated in many catalytic operations (e.g. catalytic cracking), where carbon is deposited on the catalyst, thus deactivating the catalyst. The catalyst is reactivated by burning off the carbon, which is used as a fuel in the refining process. This carbon or coke is not recoverable in a concentrated form.

## **PITCH**

Any of various dark heavy viscid substances obtained as a residue. Coal tar pitch is a component of the coal tar derived from metallurgical [coal] coke production in coke ovens, and is used in roofing, anode production, and other industrial applications. Mineral pitch is derived as a residue of petroleum distillation. The term 'pitch' is sometimes incorrectly used to describe bitumen or asphalt. Note that with respect to 'coal tar' the terms 'coal tar' and 'coal tar pitch' [carbon pitch] are not synonymous.

See: [http://www.koppers.com/htm/PandS\\_Proc\\_Main.html](http://www.koppers.com/htm/PandS_Proc_Main.html)

## **PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION (PECVD)**

Plasma enhanced chemical vapor deposition (PECVD) refers to chemical vapor deposition in which a radio frequency plasma is coupled to a low-pressure gaseous reaction mixture to facilitate the formation of the desired deposit (thin film) on a substrate located in the reaction chamber. Film formation occurs at lower temperatures with plasma versus without plasma. PECVD is used to deposit silicon dioxide, silicon nitride and silicon oxynitride films. During fabrication of a 16 Mbit DRAM device PECVD is used to deposit more than 20 layers. In addition to formation of volatile by-products, which are removed by gas flow through the reaction chamber, film deposition inexpediently forms on the reaction-chamber walls, which if not routinely cleaned will diminish process performance. Chamber cleaning is accomplished with FCs, using either an *in-situ* or a *remote* plasma cleaning step. Cleaning is accomplished by F-atoms (which are produced through plasma-induced dissociation of the FC) reacting with the inexpediently deposited silicon to form the gas SiF<sub>4</sub>, which is pumped from the chamber. Cleaning is complete when SiF<sub>4</sub> is no longer present in the chamber effluent.

## **PLASMA ETCHING**

Plasma etching refers to a method for the carefully controlled (isotropic or anisotropic) removal of material (typically silicon and aluminum) during the fabrication of very (or ultra) large scale integrated circuits. Either radio or microwave frequency radiation is coupled into a low pressure gas-mixture to ionise (plasma formation) and dissociate the gas molecules into more reactive constituents. The gas-mixture typically contains halogens such as fluorine (F), chlorine (Cl), bromine (Br) or iodine (I). Through photolithography and appropriate plasma chemistries, plasma-formed etchants directly and selectively transfer intricate patterns onto an underlying substrate. Isotropic etching is used to planarize metal layers of aluminum. To create a trench capacitor structure in a memory cell requires more than 20 different etching steps. Of the 400 or so process steps to fabricate a 16 MBit DRAM device, more than 50 are plasma etching steps (of course not all will use an FC).

## **PLUME**

The flow of pollutants from a process stack or vent into the atmosphere.

## **POWER TRANSFORMER**

A static piece of apparatus with two or more windings which, by electromagnetic induction, transforms a system of alternating voltage and current into another system of voltage and current usually of different values and at the same frequency for the purpose of transmitting electrical power.

## **POZZOLANS**

A siliceous material that in itself is not cementitious, but which develops hydraulic cement properties when it reacts with free lime (CaO) and water. Common examples of pozzolans include natural pozzolans (e.g., certain volcanic ashes or tuffs, certain diatomaceous earths, burned clays and shales) and synthetic pozzolans (e.g., silica fume, fly ash).

## **PURGE GAS**

A gas stream separated from a chemical process stream to remove impurities from the process, including volatile organic compounds, carbon monoxide, hydrogen, or other compounds. The purge gas may be burned for energy recovery or flared, or secondary products may be recovered from the purge gas.

## **RECLOSERS**

A self-controlled device for automatically interrupting and reclosing an alternating current circuit, with a predetermined sequence of opening and reclosing followed by resetting, hold-closed, or lock-out operation.

## **RECOVERY**

The collection and storage of fluorinated greenhouse gases from equipment and containers.

## **RECOVERY AND DESTRUCTION EFFICIENCY (RDE)**

This term is used primarily in the context of foams as a method of defining the overall efficiency of recovery and destruction of fluorinated gases as a percentage of the fluorinated gases that were in the foam or other product immediately prior to the commencement of the recovery process. Accordingly, this measure takes into consideration all losses associated with the recovery process as well as the destruction process and is thus distinguished from Destruction Efficiency (DE) and Destruction & Removal Efficiency (DRE) which are both limited to the activity of the destruction facility only. More information on the term is contained in the UNEP Task Force Report on Foam End-of-Life issues (2005).

## **RECOVERY EFFICIENCY**

The quantity of fluorinated greenhouse gas recovered from equipment divided by the quantity of fluorinated greenhouse gas remaining in the equipment at service or decommissioning (end of life).

## **RECOVERY FREQUENCY**

The fraction of equipment whose charge is recovered before the equipment is opened for service or is disposed of at end of life.

**REDUCTANT**

Within the Guidelines the term relates to the use of carbon as reducing agent for the reduction of metal oxides to metals, e.g. iron and aluminium, in furnaces or electrolytic processes and to the use of carbon in the production of specific inorganic products, e.g., carbides and soda ash.

**REFRIGERANT (REFRIGERATION)**

A heat transfer agent, usually a liquid, used in equipment such as refrigerators, freezers and air conditioners.

**RING MAIN UNIT**

A term describing a standard piece of switchgear for secondary distribution purposes in medium voltage systems. A Ring Main Unit is typically composed of switches/Load break switches for switching power cable rings and of switches/load break switches in series with fuses for protection of distribution transformers (transformers from medium to low voltage).

**ROAD OIL**

Any heavy petroleum oil, including residual asphaltic oil, that is used as a dust suppressant or surface treatment on roads and highways. It is generally produced in six grades from 0, the most liquid, to 5, the most viscous. Road oil was applied to gravel roads as a dust suppressant for many years. It was most commonly used in rural areas which often had a high proportion of unpaved roads and used oil markets (burning and re-refining) were located some distance away. The use of road oil for dust suppression has declined in recent years because of reductions in the proportion of unpaved roadways, the presence of highly toxic contaminants in used oils, competition from other used oil end uses (re-refining), and new environmental regulations. Synonym for slow-cure liquid asphalt.

**SEALED-FOR-LIFE EQUIPMENT**

Sealed-Pressure Systems.

**SEALED-PRESSURE SYSTEM**

Electrical equipment that does not require any refilling (topping up) with gas during its lifetime and which generally contains less than 5 kg of gas per functional unit. Distribution equipment normally falls into this category. To ensure that no refills are required during the approximately 40-year lifetime of the equipment, the Leak Rate for Sealed-Pressure Systems is generally less than 0.1 percent per year.

**SECONDARY PRODUCT**

A saleable product that is produced by a chemical process in addition to the primary product produced by the process. For example, steam cracking for ethylene production produces ethylene as its primary product, but also produces saleable propylene, butadiene, and other secondary products.

**SHIFT REACTION**

The reaction of carbon monoxide (CO) and steam (H<sub>2</sub>O) to produce carbon dioxide (CO<sub>2</sub>) and hydrogen (H<sub>2</sub>)

**SITE ERECTION EMISSIONS**

Installation Emissions.

**SLAG**

A silicate byproduct or co-product of metal smelting; the largest source of slag is the iron and steel industry. Slag is formed through the interaction of slagging (and/or fluxing) agents (commonly silica plus limestone and/or dolomite and/or lime) and the metallic ores.

**SLAGGING AGENT**

A material, such as limestone, dolomite, lime, and silica sand, which serves, through the formation of a slag, to strip impurities from ores, during the smelting of metallic ores. Slagging agents commonly perform a dual function as a flux.

**SLAKED LIME**

Common name for calcium hydroxide (CaOH) that results from the hydration of high calcium or dolomitic lime.

**SODA ASH (SODIUM CARBONATE, Na<sub>2</sub>CO<sub>3</sub>)**

Soda ash is a white crystalline solid that is used as a raw material in a large number of industries including glass manufacture, soap and detergents, pulp and paper production and water treatment. Four different processes may be used commercially to produce soda ash. Three of these processes, monohydrate, sodium sesquicarbonate (trona) and direct carbonation, are referred to as natural processes. The fourth, the Solvay process, is classified as a synthetic process.

**SOLVENT**

The component of a solution that is present in the greatest amount. It is the substance in which the one or more substances – the so-called solutes – are dissolved forming a homogenous mixture. An example of a solid dissolving into a liquid, is salt or sugar dissolving in water; but also gases may dissolve into liquids, like carbon dioxide or oxygen in water, and liquids and gases into themselves. Fossil fuels used as solvent are notably white spirit and kerosene (paraffin oil). White spirit is used as an extraction solvent, as a cleaning solvent, as a degreasing solvent and as a solvent in aerosols, paints, wood preservatives, lacquers, varnishes and asphalt products. White spirit is used in paints, lacquers and varnishes; it is the most widely used solvent in the paint industry.

**STATE-OF THE ART HANDLING EQUIPMENT**

Equipment that handles SF<sub>6</sub> at any stage of the equipment's life cycle in a manner that minimizes emissions of SF<sub>6</sub>. Such equipment typically includes a compressor, a vacuum pump, filtering units, a storage container, an evaporator, hoses and connections, piping and junctions, control instruments and (self-closing) safety valves. Most important with regard to recovery emissions is the technical capability of the vacuum pump, which should be designed for evacuation down to 1 mbar. This capability, properly used, will keep handling losses below 2 percent of the equipment's nameplate capacity.

**STEAM CRACKING**

The reaction of saturated hydrocarbons (e.g., ethane) with steam (H<sub>2</sub>O) in a furnace to produce unsaturated hydrocarbons (e.g., ethylene.).

**STEAM REFORMING**

The process of reaction of a hydrocarbon or alcohol fuel, such as natural gas or methanol, with steam to form hydrogen as a product. This is the commonly preferred method of bulk hydrogen generation. At high temperatures (700-1100 °C), steam reacts with methane (CH<sub>4</sub>) to yield synthesis gas (carbon monoxide (CO) and hydrogen (H<sub>2</sub>)).

**STOICHIOMETRIC RATIO**

Stoichiometry refers to the quantitative relationship between reactants and products in a chemical reaction. In the Minerals industry, the stoichiometric ratio is used to determine the amount of carbon dioxide (CO<sub>2</sub>) released per unit of carbonate input, and can be expressed as the molecular weight of CO<sub>2</sub> divided by the molecular weight of carbonate (e.g., 44.01g CO<sub>2</sub> / 100.09 g CaCO<sub>3</sub>).

**SUPPLEMENTAL FUEL**

Fuel provided to a chemical process, in addition to the primary feedstock to the process, to provide additional heat to the process.

**SWITCH**

A mechanical switching device, capable of making, carrying, and breaking current under normal circuit conditions, i.e., carrying the nominal load current. A switch is also called a load break switch to distinguish it from a circuit breaker. Typically switches or load break switches are used also in combination with fuses in one or more poles in series in an composite unit such as ring main units for secondary distribution purposes.

**SWITCHGEAR**

A general term covering switching devices and their combination with associated control, measuring, protective and regulating equipment, also assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures, intended in principle for use in connection with generation, transmission, distribution and conversion of electric energy.

**SYNTHESIS GAS**

A mixture of hydrogen and carbon monoxide, used to produce methanol and other chemicals.

**TAIL GAS**

The exhaust gas from a chemical process.

**TAR**

A viscous black liquid derived from the destructive distillation or pyrolysis of organic matter. Most tar is produced from coal as a by-product of metallurgical coke production in coke ovens, but it can also be produced from oil, peat or wood. See also 'Coal tar'.

**THERMAL BLACK PROCESS**

Thermal decomposition process to produce carbon black from carbon black feedstock and natural gas.

**THERMAL TREATMENT**

Combustion of organic compounds to CO<sub>2</sub> and H<sub>2</sub>O using a flame in a high temperature reaction. Thermal treatment may occur with or without energy recovery.

**THIN-FILM TRANSISTOR (TFT)**

Thin-film transistor (TFT) is the circuit element that enables frequent refreshing of flat panel displays, the circuit element that controls each pixel (or picture element) in the most common type of active matrix display. TFTs, which can be manufactured using both amorphous silicon technology on glass, plastic or thin-metal substrates and low-temperature polysilicon (LTPS) technology on glass or plastic substrates, are used in liquid crystal displays (LCDs) and increasingly in organic light emitting diode (OLED) and polymer organic light emitting diode (POLED) displays.

**TITANIUM DIOXIDE (TiO<sub>2</sub>)**

Titanium dioxide is the most important white pigment. The main use is in paint manufacture followed by paper, plastics, rubber, ceramics, fabrics, floor covering, printing ink, and other miscellaneous uses.

**USE EMISSIONS (FOR PURPOSES OF CHAPTER 8)**

The emissions from a piece or type of equipment between its installation and disposal or between its installation and final refill, depending on the context. Use Emissions include emissions during operation, maintenance, and service of the equipment, as well as emissions associated with equipment failures. Use Emissions include and are generally significantly larger than Leakage, particularly when State-of the Art Handling Equipment is not used. In these Guidelines, Use Emissions associated with the Emission Factor Approach (Tiers 1, 2, and the Emission-Factor variant of Tier 3) include Final Use Emissions, while Use Emissions associated with the Mass-Balance Approach (the Mass-Balance variant of Tier 3) exclude Final Use Emissions.

**USE EMISSION RATE (FOR PURPOSES OF CHAPTER 8)**

The Use Emissions over a given period of time, usually a year, divided by the Nameplate Capacity of the equipment. The Use Emission Rate includes emissions during operation, maintenance, and service of the equipment, as well as emissions associated with equipment failures. In general, the Use Emission Rate is significantly higher than the Leak Rate. In these Guidelines, the Use Emission Rate associated with the Emission Factor Approach (Tiers 1, 2, and the Emission-Factor variant of Tier 3) includes Final Use Emissions.

**VENTING**

Controlled release of natural gas and waste gas/vapour streams.

## **WHITE SPIRIT**

Refined distillate intermediates with a distillation in the naphtha/kerosene range between 135°C to 200°C. In contrast, industrial spirits (specific boiling point, SBP) are light oils distilling between 30°C and 200°C. There are 7 or 8 grades of industrial spirit, depending on the position of the cut in the distillation range. The grades are defined according to the temperature difference between the 5 percent volume and 90 percent volume distillation points (which is not more than 60°C). White spirit is an industrial spirit with a flash point above 30°C.

**Abbreviation**

AGO	Australian Greenhouse Gas Office
APME	Association of Plastics Manufacturers Europe
AWACS	Airborne Warning and Control System
BAT	Best Available Techniques
BFC	Blast Furnace Gas
BOF	Basic Oxygen Furnace (steelmaking)
BREF	Best Available Techniques Reference Documents (under European Integrated Pollution Prevention and Control Bureau.) <a href="http://eippcb.jrc.es/pages/FActivities.htm">http://eippcb.jrc.es/pages/FActivities.htm</a>
C4 +	By-product hydrocarbons containing more four or more carbon atoms (e.g., butanes, pentanes, hexanes, heptanes)
CaCO <sub>3</sub>	Calcium carbonate
CaO	High calcium lime
Ca(OH) <sub>2</sub>	Slaked high-calcium lime
Ca(OH) <sub>2</sub> • Mg(OH) <sub>2</sub>	Slaked dolomitic lime
CaO•MgO	Dolomitic lime
CKD	Cement Kiln Dust
CIGRE	International Council on Large Electric Systems
COG	Coke Oven Gas
DOE	United States Department of Energy
DRE	Destruction or Removal Efficiency
DRI	Direct Reduced Iron
EAF	Electric Arc Furnace (steelmaking)
EDC	Ethylene Dichloride
EG	Ethylene Glycol
EO	Ethylene Oxide
FEPC	The (Japanese) Federation of Electric Power Companies
FGD	Flue Gas Desulphurisation
FgH-ISI	Fraunhofer-Institut für Systemtechnik und Innovationsforschung
GCB	Gas Circuit Breakers
GIL	Gas Insulated Lines
GIS	Gas Insulated Switchgear and Substations
GIT	Gas Insulated power Transformers
HBI	Hot Briquetted Iron
HMA	Hot Mix Asphalt
HV (Switchgear)	High Voltage (Switchgear) for rated operating voltages above 52 000 Volts
IEC	International Electro-technical Commission
ITs	Instrument Transformers
JEMA	The Japan Electrical Manufacturer's Association
LKD	Lime Kiln Dust

LVOC	Large Volume Organic Chemical
LVIC	Large Volume Inorganic Chemical
MgCO <sub>3</sub>	Magnesium carbonate
MV (Switchgear)	Medium Voltage (Switchgear) for rated operating voltages above 1 000 Volts and up to 52 000 Volts
OHF	Open Hearth Furnace (steelmaking)
PC	Portland cement
PECVD	Plasma Enhanced Chemical Vapor Deposition
RDE	Recovery and Destruction Efficiency
TFT	Thin-Film Transistor
VCM	Vinyl Chloride Monomer