

## Glossary

### • Aromatics

Compounds that have benzene and benzene rings as part of their chemical structure. They may have two or more condensed aromatic rings, or the hydrogen atoms on the ring may be replaced by a member of the alkyl group (toluene, xylene, etc.)

### • Atmospheric distillation unit

Crude oil is composed of a variety of hydrocarbon compounds. The atmospheric distillation unit takes advantage of the different boiling points of these compounds to “crack” crude oil into separate fractions—gasoline, kerosene, gas oil, heavy fuel oil and other components—under atmospheric pressure. In general, the scale of a refinery is defined by the process capacity of its atmospheric distillation unit.

### • Barrel

A unit for expressing oil volume, equivalent to approximately 159 liters.

### • Catalytic reformer

A unit that raises the octane number of naphtha that has been cracked by the atmospheric distillation unit, producing a gasoline component. Hydrogen, a by-product of chemical reactions in this unit, is used in desulfurization.

### • COD

Refers to chemical oxygen demand, an indicator of water pollution. Expresses the volume of oxygen required for oxidation of oxidizable substances (organic matter, etc.) in water.

### • Cogeneration system

An energy supply system that uses heat emitted at the time of electricity generation to meet demand for heat for heating, cooling or hot water. This is expected to lead to an improvement in integrated energy efficiency.

### • Crude oil equivalent throughput

Value used when calculating the unit energy consumption of a processing equipment, which is obtained by converting the volume of oil passing through it into an equivalent amount of crude oil processed by the atmospheric distillation unit. This value is meant to reflect the operating conditions of each equipment, offsetting discrepancies in the type and structure of facilities used in different refineries. The crude oil equivalent throughput of a processing equipment is derived by: [throughput volume] x [complexity factor]. The complexity factor of a given equipment is its construction cost per throughput, relative to the atmospheric pressure distillation unit (whose complexity factor is 1). The crude oil equivalent throughput of a refinery on the whole is the aggregated crude oil equivalent throughput values of its entire processing equipment fleet.

### • Electrostatic precipitator

An electrostatic precipitator is a device that administer an electric charge to fine particles and liquid mist, etc. floating in gas and removes them using electrostatic energy. Highly efficient collection of even fine particles is possible with low pressure loss, so this equipment is widely used at large scale generating facilities such as thermal power stations.

### • Exhaust gas denitrizer

A device for removing NOx from exhaust gas. One method involves reduction using ammonia and a catalyst, and another method involves having NOx absorbed by an absorbing liquid.

### • Fluid catalytic cracking unit

This unit uses a minute-particle catalyst to crack heavy fuel oil. The cracked oil is divided into LPG, gasoline, gas oil and heavy fuel oil. The gasoline component produced by this unit has a high octane number, and accounts for a high proportion of ingredients mixed in other products.

### • Hydrocarbon vapor

Hydrocarbon vapor is a type of hydrocarbon steam generated by gasoline, benzene or toluene. In most cases it diffuses from oil depots, loading zones for oil tankers or distribution bases for chemical products. It is recognized as one of the causes of photochemical smog and malodor.

### • Hydrodesulfurization unit

This is unit that uses catalysts, makes the sulfur compounds contained in petroleum react with hydrogen, turns the sulfur to hydrogen sulfide, and eliminates it. This unit can be used for desulfurization of naphtha, kerosene, gas oil, and heavy fuel oil, among others.

The gas oil hydrodesulfurization unit has been reinforced in accordance with stricter restrictions on sulfur content and in lines with voluntary goals to reduce sulfur content. The heavy fuel oil desulfurization unit is distinguished between the direct desulfurization unit and the vacuum gas oil hydrodesulfurization unit. The direct desulfurization unit desulfurizes the atmospheric residue that remains after separation by the atmospheric distillation unit, while the vacuum gas oil hydrodesulfurization unit desulfurizes the vacuum gas oil after separation of the asphalt fraction using the vacuum distillation unit. The FCC gasoline desulfurization unit that was introduced to 3 refineries in Fiscal 2004 significantly reduces the octane number when the FCC gasoline is desulfurized in its original state, and for that reason, the newest technology that desulfurizes only the portion with high sulfur content and low octane number is used.

- **NO<sub>x</sub> (nitrogen oxide)**

A collective term for nitrogen oxides, of which the principal air pollutants are nitrogen monoxide and nitrogen dioxide. Most factory smoke and automobile exhaust gas consist of nitrogen monoxide, which under the influence of ultra-violet rays, reacts with oxygen and ozone to form nitrogen dioxide. Nitrogen dioxide is the subject of air pollution controls based on health concerns. Nitrogen oxides are a cause of photochemical smog, and also of "acid rain" the same as sulfur oxides. Dinitrogen monoxide (nitrous oxide) is also a greenhouse gas.

- **Octane number**

The octane number is one gauge of motor gasoline quality. The higher the octane number, the less engine knocking will occur. JIS standards specify an octane number of at least 89.0 for regular gasoline, and at least 96.0 for premium gasoline.

- **Oil boom**

A boom to prevent oil from spreading on the surface of the sea. It is located on piers and is extended over the water surface by tugboats.

- **Particulate matter (PM)**

Particulate matter in the atmosphere. Suspended particulate matter (SPM) is held to be a cause of air pollution, and is defined as particulate matter suspended in the air with a particle diameter of 10 $\mu$ m or less. "Minute-particle matter", where the particle diameter is 2.5 $\mu$ m or less, is called PM<sub>2.5</sub>, and is regarded as a cause of asthma and bronchitis.

- **PCB**

Stands for Polychlorinated Biphenyl, an excellent thermostat and electrical insulator, having been used in transformers, condensers, heat transfer media and carbonless paper. However, PCBs are difficult to dissolve, accumulate in the body and are toxic, causing skin problems and damage to liver functions. Currently the manufacture and import of PCBs is in principle prohibited, and their storage and disposal is controlled by law.

- **PRTR**

Stands for Pollutant Release and Transfer Register. Businesses must keep track of, and report to the authorities the volumes of releases into the air, water and soil and the transfers outside their plant as waste material of prescribed chemical substances. Enacted in 1999, the system came into force in 2001.

- **SO<sub>x</sub> (Sulfur oxide)**

A collective term for oxides of sulfur, of which the principal air pollutants are sulfur dioxide, sulfur trioxide and sulfur mist generated by the combination of the sulfur oxides with water in the air. When sulfur oxides react with water they show strong acidity, and are a cause of acid rain.

- **Sulfur free fuel**

Automobile fuel having sulfur content not exceeding 10ppm. Planned to be introduced in Europe in 2009.

- **Sulfur recovery unit**

The unit collects sulfur from by-product gases containing hydrogen sulfide emitted from hydrodesulfurization unit or other oil refinery facilities. Large quantity of sulfur oxide is emitted when gases containing hydrogen sulfide are directly used as fuel. Oil refineries therefore remove hydrogen sulfide from by-product gases before using them as fuel, and collect sulfur from the hydrogen sulfide.

- **Sour water treatment unit**

The wastewater discharged from hydrodesulfurization units and other refinery equipment contains hydrogen sulfide and other odorous materials. This unit uses steam injection to remove odorous materials. The hydrogen sulfide removed by this unit is then processed by the sulfur recovery unit.

- **Unit energy consumption**

It is a value calculated when dividing total energy consumption at oil refinery by crude oil equivalent throughput. The unit is "kl-crude oil/1000kl". Total energy consumption is converted into crude oil, and the unit is "kl of crude oil".

- **Vacuum distillation unit**

A unit that distills under reduced pressure. When oils with a high boiling point, such as heavy fuel oils, are heated, they may break down before vaporization can happen. By reducing the pressure in the unit, the boiling point of the oil is reduced, allowing for efficient cracking of fractions.

- **VOCs (Volatile Organic Compounds)**

This is generic term for organic compounds that can easily vaporize at ambient temperatures. VOCs include hydrocarbons such as toluene, benzene, and xylene which are produced during the refining process of petroleum, as well as a variety of other substances such as chlorofluorocarbons, formaldehyde, trichloroethylene, tetrachloroethylene, etc. When VOCs are released into the air, the chemical reaction is said to be related to the production of oxidants and SPMs (suspended particulate matter).