The Quality Control of Petroleum Products and Reduction of Environmental Impacts from the Customer Use of Products

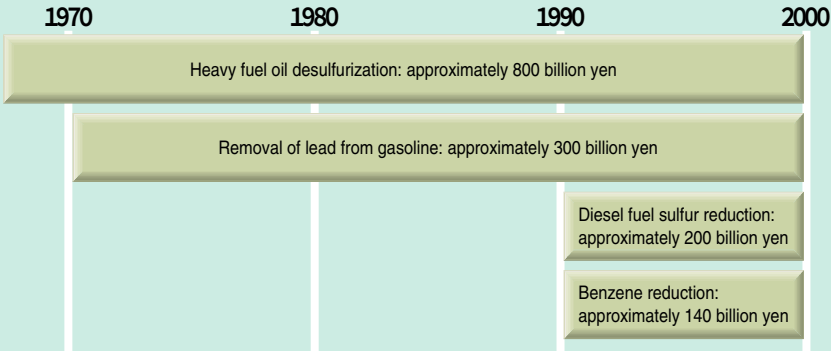
Japan is largely dependent on Middle East crude oil, which contains a high quantity of sulfur compared to African and North Sea crude oil. Therefore, producing materials that have less environmental impacts from Middle East crude oil requires far more advanced refining facilities. Japan's petroleum industry has been investing heavily in desulfurizers and other facilities to reduce environmental pollution. As a result, we have been providing products that are least damaging to the environment compared with many other companies around the world.

Cosmo Oil has been developing technologies for fuel desulfurization and further improvement of fuel quality as a top priority in order to provide products that meet the needs of society while conserving energy. We will continue to focus on research and development such as the development of catalysts for desulfurization of petroleum products to provide customers with products that cause less environmental impacts when they are used.

***1 MTBE:** Taking the environmental impacts of MTBE into consideration, Cosmo Oil suspended shipments of gasoline with MTBE as an additive in 2001.

***2** Benzene has received attention for its adverse effects on the human body. Japan's Ministry of the Environment classified it as a high-priority harmful air pollutant, although its effects on living organisms are not completely clear.

Environmental Protection and Plant Investment (Totals for Japan Petroleum Industry)



• Gasoline

The Japanese petroleum industry has been promoting the switch to lead-free gasoline, benzene reduction, and sulfur reduction to reduce the environmental impact of gasoline.

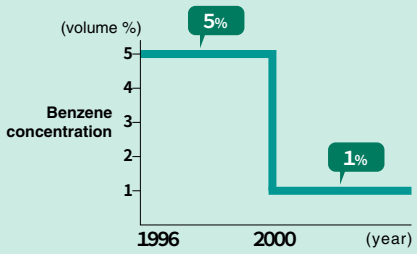
In the 1960s, when high economic growth resulted in the rapid spread of the automobile throughout society, 4-alkyl lead was added to gasoline to increase the octane number. In 1970, however, lead pollution in the Shinjuku area of Tokyo highlighted the toxicity problem of 4-alkyl lead. To respond to exhaust gas regulations and to solve the problem of lead, the idea of moving to lead-free gasoline was considered and as a result, regular gasoline became entirely lead-free by 1975. Lead-free premium gasoline was placed on the market in 1983 and the production and sale of all leaded gasoline were terminated in 1986.

The History of Gasoline Quality Improvement in the Japanese Petroleum Industry

1950 Gasoline production begins
1970 Shinjuku-ku, Tokyo air pollution incident
1975 Sales of non-leaded regular gasoline begin
1986 Sales of non-leaded premium gasoline begin
1987 Sales of 100-octane premium gasoline begin
1991 Sales of MTBE (methyl tertiary butyl ether) blended premium gasoline begin*1
1996 Revision of the JIS (benzene less than 5.0 volume percent, sulfur content of less than 100 ppm, and MTBE less than 7.0 volume percent)
2000 Regulation for benzene content of one volume percent

New Japanese regulations that came into effect from April of 1996, also limit benzene*2 in gasoline to less than five volume percent. In addition, the Petroleum Council decided in 1996 to move toward the reduction of benzene to less than one volume percent. Low-benzene gasoline with less than one volume percent benzene actually began shipping from January 2001.

Changes in Benzene Concentration in Gasoline



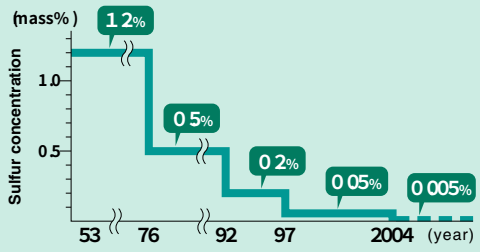
Sulfur that is burned and emitted into the atmosphere causes major environmental problems such as acid rain. Although regulated by the JIS to less than 0.01 mass percent (100 ppm), Cosmo Oil ships its premium gasoline with a level of only 0.0005 mass percent and regular gasoline at 0.003 mass percent (figures for FY 2001)—figures dramatically lower than regulation figures for sulfur content. The Reid Vapor Pressure of gasoline during summer was lowered from 78 kPa to 72 kPa in 2001 in order to reduce hydrocarbon vapor emissions, which are a cause of photochemical smog.

• Diesel Fuel

To reduce the amount of sulfur in diesel fuel, the Japanese petroleum industry began the installation of desulfurization units in oil refineries, particularly hydrodesulfurization facilities, from the latter half of the 1950s. Sulfur levels in diesel fuel were reduced to 0.2 mass percent in 1992, which were further reduced to less than 0.05 mass percent from 1997. Cosmo Oil ships diesel fuel with a sulfur level of 0.04 mass percent (figures for FY 2001).

Changing regulations for diesel exhaust gases mean that the allowable sulfur content of diesel fuel is expected to be further reduced to 0.005 mass percent (50 ppm). Demonstration tests are currently being conducted at Sakaide Oil Refinery, using the existing catalysts to provide high-level desulfurization with a view to producing diesel fuel with a sulfur level of less than 50 ppm. We are developing high-performance catalysts in cooperation with the New Energy and Industrial Technology Development Organization (NEDO). We plan to start the distribution of diesel fuel with lower sulfur content in Tokyo from September 2002.

Changes in Diesel Fuel Sulfur Content Regulation



• Kerosene

In Japan, where kerosene-fueled heaters are widely used in homes, sulfur content has long been strictly regulated to protect public health. The current JIS are for sulfur levels of 0.008 mass percent (80 ppm), but Cosmo Oil kerosene was shipped at 0.004 mass percent (figures for FY 2001)—far below the statutory standard.

• Heavy Fuel Oil

Sulfur oxides (SOx), which are released when heavy fuel oil burns, were a serious source of pollution in heavily industrialized areas during the high economic growth period of the 1960s. With the enactment of the Basic Law for Environmental Pollution Control in 1967, the public and government began the work of preventing air pollution.

The petroleum industry responded by importing low-sulfur crude oil and rapidly deploying heavy fuel oil desulfurizing units. By 1980, 44 direct heavy fuel oil desulfurization units and a number of indirect desulfurization units had been constructed. Since then, progress has continued in other areas where heavy fuel oil is used, such as flue gas desulfurization facilities, and the concentration of SOx has improved to a degree seen in few other countries.

In response to the recent fall in demand for heavy fuel oil, Cosmo Oil further refines low-sulfur heavy fuel oil produced through direct heavy fuel oil desulfurization units for low-sulfur fuel oils such as diesel fuel and gasoline that have higher added-value than heavy fuel oil.