

Fuel Oil Quality Regulations and Responses

Japan is largely dependent on Middle East crude oil, which is relatively heavy and contains a comparatively high quantity of residual fraction and sulfur. Compared to the lower-sulfur African and North Sea crude oil supplied to Europe and North America, producing materials suitable for the protection of the environmental from Middle East crude oil—gasoline, kerosene, diesel fuel oil and heavy fuel oil—requires far more advanced refining facilities. Japan's petroleum industry has been actively investing in desulfurizers and other facilities, and has worked for the reduction of environmental pollution. As a result, we provide world-level products with excellent environmental qualities. For the future, quality regulations for environmental protection will continue to move to even greater strictness.

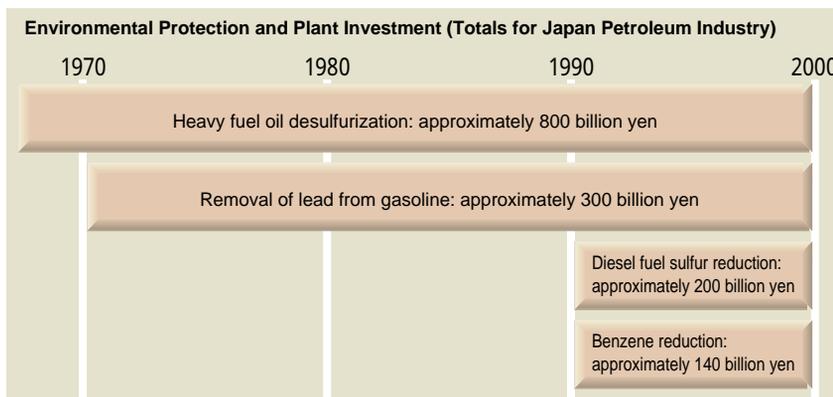
functioning of catalytic converters in cleaning exhaust gases, the idea of moving to lead-free gasoline was considered.

As a result of research conducted by a partnership of Japan's petroleum industry and automotive industry, regular gasoline was entirely lead free by 1975. Lead-free premium gasoline was placed on the market in 1983; with cars prone to valve recession (a phenomenon in which the seats of exhaust valves are worn away when non-leaded gasolines are used) disappearing from the market, the production and sales of all leaded gasoline was terminated in 1987.

Benzene Reduction

Benzene has received attention for its influence on the human body, with Japan's Ministry of the Environment classifying it as a high-priority harmful air pollutant. While the exact influences on living organisms are not completely clear, new Japanese regulations to reduce air pollution which came into effect from April of 1996 limit benzene concentrations in gasoline to less than five percent.

In addition, the Petroleum Council decided in 1966 to move toward reduction of benzene to the one percent level, with the petroleum industry moving to make the necessary changes to oil refinery facilities. Low-benzene gasoline with less than one percent benzene actually began shipping from January of 2000.

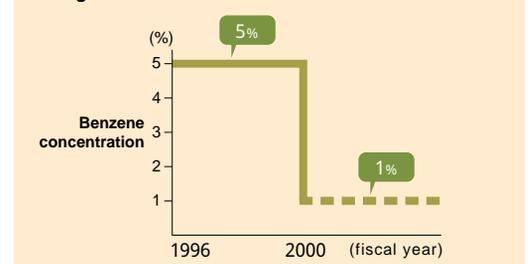


The History of Gasoline Quality Improvement in the Japanese Petroleum Industry

- 1950 Gasoline production begins
- 1970 Shinjuku-ku, Tokyo air pollution incident
- 1975 Sales of non-leaded regular gasoline begin
- 1983 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*
- 1996 Revision of JIS standard (benzene less than 5.0 percent, sulfur content of less than 100 ppm, MTBE less than 7.0 percent)
- 2000 Regulation for benzene content of one percent

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

Changes in Benzene Concentration in Gasoline



Gasoline

The Move to Lead-Free

In the 1960s, when the surge of economic growth resulted in rapid adoption of the automobile by wide sections of 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's obstruction of the

Sulfur Content

Sulfur discharged into the atmosphere is a cause of major environmental problems such as acid rain. Although regulated by the JIS standard to less than 0.01 percent (100ppm), Cosmo Oil ships its premium gasoline with a level of only 0.0005 percent (actual result for FY 2000) and regular gasoline at 0.003 percent (figures for FY 2000)—figures dramatically lower than regulation figures for sulfur content.

Diesel Fuel

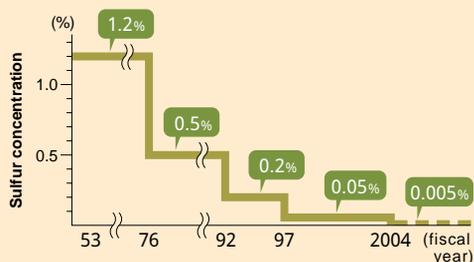
From High to Super-High Levels of Desulfurization

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. Particularly in recent years, air pollutants such as nitrogen oxide and suspended particulate matter in large cities mean that considerable time will be needed to achieve environmental quality standard levels, so the Central Environmental Council of the Environmental Agency (today's Ministry of the Environment) announced that, until diesel trucks and buses can be fitted with exhaust gas recycling (EGR) devices, sulfur levels in diesel fuel would be reduced to 0.2 percent from October of 1992. The Council continued that, in the long run, until aftertreatment devices can be put into practical use, sulfur levels are to be reduced to less than 0.05 percent. From 1997, shipping of diesel fuel with sulfur levels of less than 0.05 percent began.

Cosmo Oil ships diesel fuel with a sulfur level of 0.04 percent (year 2000 figure), below the regulation level of 0.05 percent.

Changing regulations for diesel exhaust gases mean that the allowable sulfur content of diesel fuel is expected to be further toughened to 0.005 percent (50 ppm). At Cosmo Oil, we are also moving to super-low desulfurization with strengthening of our infrastructure, including the implementation of a deep desulfurization unit as well as technological development such as improvements to catalysts to provide high-level desulfurization at existing facilities.

Changes in Diesel Fuel Sulfur Content Regulation



Kerosene

Surpassing JIS Standards

In Japan, where kerosene-fueled heaters are widely used in homes, sulfur content has long been strictly regulated to ensure public health. Current JIS standards are for sulfur levels of 0.008 percent (80 ppm), but Cosmo Oil kerosene shipped at 0.003 percent in 2000—far below the statutory figure.

Heavy Fuel Oil

Dramatically Strengthening Desulfurization Devices in the 1970s and 80s

The sulfur oxide (SOx) released when heavy fuel oil burns was a serious source of pollution in heavily industrialized areas as early as 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 with the import of low-sulfur crude oil and the rapid implementation of heavy fuel oil desulfurizing units. By 1980, 44 direct heavy fuel oil desulfurization units and a number of indirect desulfurization units were 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 places around the world.

Cosmo Oil is increasingly using the low-sulfur heavy fuel oil produced by direct heavy fuel oil desulfurization units as the raw material for other value-added, low-sulfur fuel oils such as diesel fuel and gasoline.