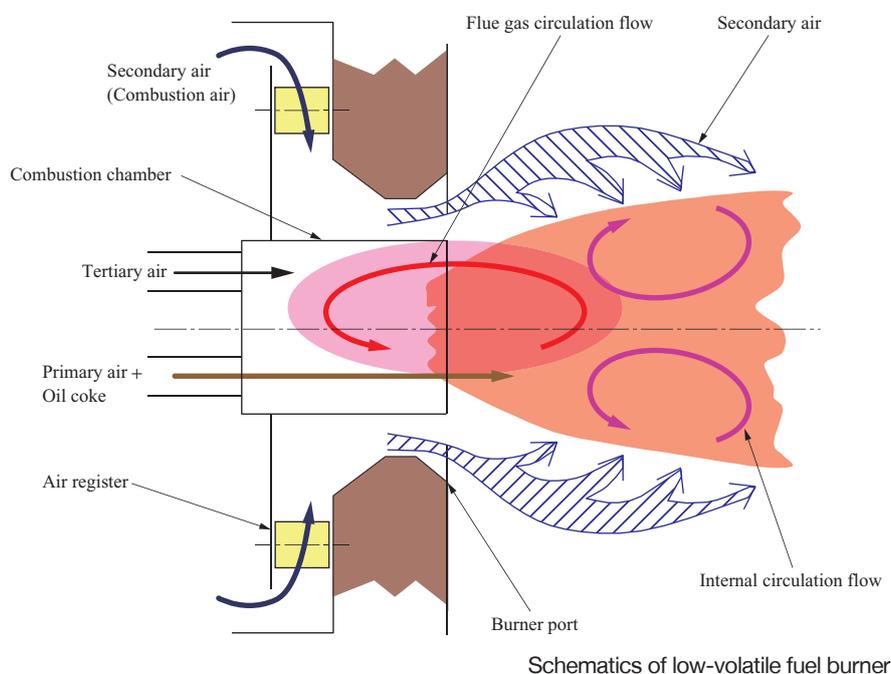


# Eco-Boiler, Saving Heavy Fuel Oil

## Low-volatile fuel burners enable burning oil-coke without assisting combustion with heavy oil

In the spring of 2015, we introduced low-volatile fuel burners into a boiler plant operated on oil coke and heavy oil. Stable combustion of oil coke is difficult to achieve by conventional techniques. This burner eliminates the use of heavy oil that helps achieve stable combustion and thereby contributes to fuel cost reduction.



Solid fuels include coal, woody biomass, oil coke, and other types of fuels. The combustion characteristics of each type of fuel are very different. In Japan, boilers for coal-fired power generation are operated mainly on bituminous coal, that is rich in volatile components and has a high heating value. Its consumption accounts for more than 70% of the total coal consumption in Japan. Since bituminous coal is easy to handle and has a high heating value, it is a relatively expensive, compared with other types of coal.

In contrast, some fuels are inferior in ignitability due to the low proportion of volatile components and are therefore relatively inexpensive. Such fuels are also used for power generation, industrial furnaces, and other applications. Oil coke is produced from the residue left behind the thermal

decomposition of heavy distillate. Although it has a high heating value, it is far from easy to use because it is low in ignitability due to the low level of volatile components. In conventional combustion of oil coke as a fuel for boiler plants, heavy oil has been needed to assist the combustion. Since heavy oil is considerably more expensive than bituminous coal, its use is a predominant factor in increasing fuel costs.

Combustion of oil coke without using heavy oil would provide a significant advantage in cost for our clients operating a boiler plant. We therefore started developing a low-volatile fuel burner capable of combusting low-volatile fuel without using heavy oil to assist combustion.

## Mechanism of the low-volatile fuel burner

The low-volatile fuel burner is characterized by its combustion chamber. Within the combustion chamber, fuel is heated in order to increase its ignitability and stabilize combustion. Combustion air (secondary air) passes through vanes called air registers to form swirling flows when blown from the outside of the chamber into a furnace. This process forms internal circulation flows near the burner, allowing hot furnace gas to be entrained into the region near the burner. In addition, the fuel and primary air that are blown through the lower portion of the inside of the combustion chamber serve to form a flue gas circulation flow within the combustion chamber. These circulation flows formed by the primary air and the combustion air (secondary air) allow hot flue gas to be entrained into the combustion chamber. The entrained hot flue gas is mixed with supplied fuel, heating it in the process. The entrainment of hot flue gas into the combustion chamber can be adjusted to be at an optimum level by using the flow of tertiary air, which is supplied from the upper portion of the chamber.

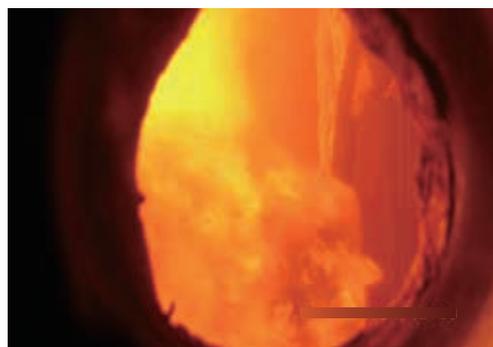
## Successful oil-coke solo-combustion

In the spring of 2015, we introduced three low-volatile fuel burners into an actual boiler plant and successfully achieved oil-coke solo-combustion. Although heavy oil is still needed to raise the temperature when heating up the boiler, the supply of heavy oil was stopped once the temperature got up to desired value. We shifted the three burners to the solo-combustion mode one by one and finally achieved oil-coke solo-combustion with all three burners. The flow of furnace gas entraining into the combustion chamber could be seen through an observation hatch, and a clear, bright flame was observed coming up from the bottom of the combustion chamber.

After achieving oil-coke solo-combustion, we adjusted the operation of the low-volatile fuel burners to keep them in an optimum state. Although the combustion chamber is a highly heat-resistant casting, it may be damaged if its surface temperature exceeds its design temperature. The strength of internal circulation flows therefore needs to be at an optimum level so that the surface temperature of the chamber will not exceed a certain value. On the outer surface of the combustion chamber, multiple thermocouples for monitoring the temperature are installed in the longitudinal and circumferential directions. The strength of the internal circulation flows is controlled by adjusting the tertiary-air flow on the basis of temperature data measured with the thermocouples. We also confirmed that when the air-register opening and the boiler load were changed, circulation flows within the combustion chamber were maintained in an appropriate state by controlling the tertiary-air flow. After confirming operation in solo-combustion mode, deliver to the client was completed.



Actual low-volatile fuel burner delivered to a customer



Flame from solo-combustion of oil coke inside the low-volatile fuel burner

## Making eco-boilers that deliver higher performance

The combustion efficiency of the boiler operating under oil-coke solo-combustion was as high as that of a boiler operating under co-combustion with heavy oil. We therefore confirmed that low-volatile fuel burners are capable of ensuring combustibility equivalent to that achieved by co-combustion with heavy oil. We also confirmed that the introduction of the low-volatile fuel burners reduced heavy oil consumption by approximately 200 liters/hour. We will propose planned burner maintenance to the client so that the burners can be used for a long time to come. Supplying our low-volatile fuel burners for a wider range of applications is expected not only to produce economical advantages due to reduction in heavy oil consumption but also to expand the use of the fuels that have not been used. We will continue to contribute to the effective use of finite energy sources.

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