

● Measurement and Removing Technology of Coal Containing Microelements

1. Purpose

In order to supply energy stably to Japan for long term, coal is believed to play an important role among other energy sources for it is globally rich in its mining reserves with less regional maldistribution. However, in the use of coal, there could occur a serious problem that, together with SO_x and NO_x, some other environmentally burdening materials of **such microelements as Mercury, Chlorine**, etc. would be inevitably accompanied with its combustion.

Initially, this R&D became necessary in the study of movement about the flue gas emission regulation on the combustion of coal in the western countries, and we learned that they spent a lot of efforts to measure the amount of microelements contained in the feed coal and its ash, and also that they had not established their necessary eliminating technology although most of the above-mentioned microelements were emitted freely to the atmosphere. Then, we decided to contribute to clarify the behaviors of those microelements and also to develop their emission eliminating technology **by means of quick extracting the microelements of the coal and its ash to allow a comprehensive quicker analysis as much as possible.**

In particular, regarding Mercury (Hg) its emission standard seems to be enacted in near future, and then **a continuous monitoring technology is to be developed together with its analysis of behavior during the coal combustion, as well as, Mercury (Hg) eliminating technology.**

2. Schedule of R&D

	FY1999	FY2000	FY2001	FY2002	FY2003
Survey and Study					
(1) Behavior and Reduction method of microelements					
(2) Trends on regulations against emission of microelements					
R&D on each technical elements					
(1) High level analysis method for microelements					
a) Quick measuring method for microelements in coal and coal ash					
b) Continuous monitoring method for Hg in flue gas					
(2) Elimination method for Hg using adsorbing reagent in furnace					
a) Clarification of behavior of microelements during combustion process					
b) Elimination method for Hg, etc. using absorbing agent in furnace					

3. Targets of the R&D

R&D items	Targets
(1) High level analysis method for microelements	
a) Quick measuring method for microelements inside coal and coal ash	<ul style="list-style-type: none"> - Using microwaves, the time for pre-treatment (preparation a solution for ICP/ MIP-MS analysis) is to be shorten within 4 hours. - Microelements for the measurements is to be As, Be, Cd, Co, Cr, Mn, Ni, Pb, Sb and Se. - In comparison with analysis data using resolution by acid, its differences is to be in the extent of +/- 10%.
b) Continuous monitoring method for Mercury (Hg) in flue gas	<ul style="list-style-type: none"> - Establishment of the continuous monitoring method for Mercury (Hg) in flue gas. - Limit of the measurement: 1mg/Nm³
(2) Eliminating method for Mercury using adsorbing agent in furnace	
a) Grasp of behavior of microelements during combustion process	<ul style="list-style-type: none"> - Clarification of sectional behavior of Mercury (Hg) in the area from inlet to outlet of combustion furnace.
b) Eliminating method for Mercury (Hg), etc. using adsorbing agent in furnace	<ul style="list-style-type: none"> - Outside emission amount of Mercury (Hg) contained in coal is to be 10% or less. (Estimated amount of the outside emission of Hg in case of the case using no elimination method is 30% to 50%)

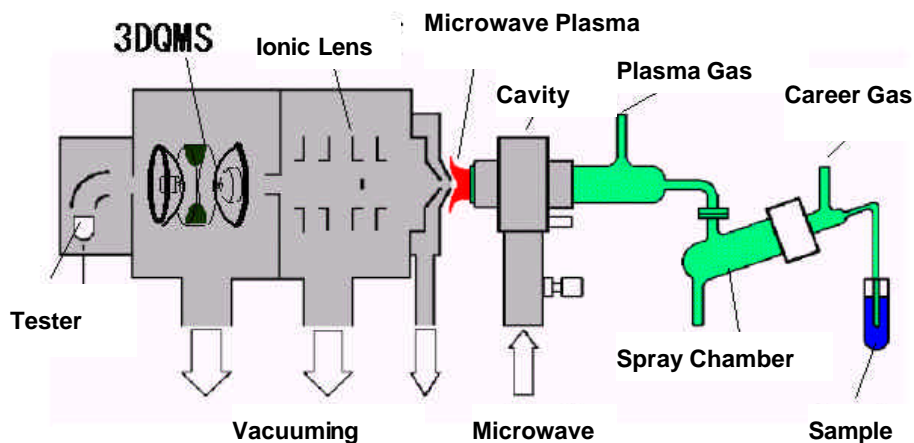
4. Explanation of Each R&D items

(1) Quick Measuring Technology for Microelements

A new quickly measuring technology for the extracted microelements is to be developed by means of either a microwave plasma mass analyzing apparatus (MIP-MS) or an induction combined plasma mass analyzing apparatus, both of them use preliminarily extracted microelements prepared by a micro-wave process.

- Preliminary processing method by microwave (extraction of microelements)**
- Simultaneous measuring technology for multiple microelements by either MIP-S or ICP-MS**
- Development of Continuous Monitoring Technology for Mercury contained in Flue Gas**

Concept of the Microwave Plasma Mass Measuring Apparatus



(2) In-furnace Mercury Eliminating Technology Development by Adsorption Reagent

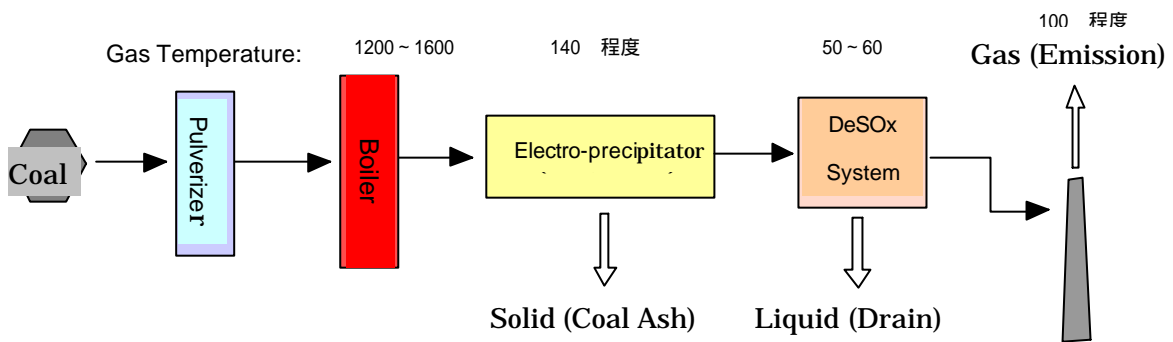
a) Clarification of Mercury Behavior during the Combustion process

Occurrence and behavior of Mercury in the bench plant for pulverized coal combustion are to be quantitatively analyzed. Additionally, its in-furnace behavior would be studied by modeling method, and then characteristics of the Mercury adsorption will be checked.

b) Development of In-furnace Eliminating Technology of Mercury, etc. by Adsorption Reagent

It plans to develop a Mercury and other elements eliminating technology in which we can easily exclude them by using a dust collector, etc. after the combustion residues are adsorbed by the splashed grains of limestone and unused calcium, etc. in the combustion furnace. In parallel, fixation of halogens such as chlorine, fluorine, etc. and adsorption characteristics of other microelements will be also investigated.

Behavior of Microelement Metals in a Pulverized Coal Firing Boiler



Classification by Volatility	第群	Sectional Emission Ratio (%)	Gas Temperature: 1200 ~ 1600				140 程度				50 ~ 60				100 程度			
			↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
第群	Al, Ca, Co, Cr, Fe, Mg, Mn, Ni, Si)	3.9%	95.1%	0.9%	0.10%	1.7%	96.8%	1.4%	0.07%	0.1%	33.3%	36.0%	30.6%	0.1%	0.6%	58.0%	41.3%
	As, B, Be, Cd, Cu, Mo, Pb, Sb, Se, Zn, V		0.1%	33.3%	36.0%	30.6%	0.1%	0.6%	58.0%	41.3%	0.1%	0.2%	95.1%	4.6%				
Hg	0.1%		33.3%	36.0%	30.6%	0.1%	0.2%	95.1%	4.6%									
F	0.1%		33.3%	36.0%	30.6%	0.1%	0.2%	95.1%	4.6%									
Cl	0.1%		33.3%	36.0%	30.6%	0.1%	0.2%	95.1%	4.6%									

Concept of the bench plant for pulverized coal combustion

内径：300 mm
 炉長：2800 mm
 一次空気量：6 m³N/hr
 二次空気量：30 ~ 40 m³N/hr
 二段燃焼用空気量：12 ~ 22 m³N/hr
 二段燃焼用空気吹き込み位置：
 バーナーより 1163 ~ 1666mm
 空気予熱温度：350
 石炭供給速度：6 ~ 7 kg/hr

