B-16 Development and Assessment of Strategy and Technology for Controlling CH_4 and N_2O to Reduce Global Warming (Final Report)

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The final goal of this project study is, to develop and establish the effective technology for controlling CH_4 and N_2O emitted from the human activity, and to assess the effectiveness of the developed technology.

Beginning with agricultural land, field experiments performed concerning different fertilizers, fertilization methods, and other approaches to fertilization management practiced on dry fields clarified the management method best suited to reduce the generation of N_2O. And paddy field management methods that similarly prevent the generation of CH_4 and N_2O were proposed and the prevention effects of different varieties were studied. To improve livestock farming related measures, equations to estimate the quantity of CH_4 discharged by fattening cattle and the quantity of nitrogen in their excreta were prepared, and it was clearly shown that the quantity of CH_4 generated and the quantity of nitrogen in the excreta per unit daily growth (DG) of fattening cattle fall as the DG increases. The flux of N_2O and CH_4 and the quantity and types of meadow grass harvested when the type of fertilizer applied to meadows is varied were measured, revealing that varying the fertilizer lowers the quantity of N_2O generated, and a fertilizer management method involving the use of fertilizer containing a denitrification inhibitor or a slowly available nitrogen fertilizer that do not seriously reduce the yield or cause other severe problems was planned. As a way to reduce N_2O discharged by combustion, a pre-processing method that separates the volatile portion that is the precursor of N_2O during combustion was studied to find a way to reduce N_2O generation from stationary combustion facilities, confirming that although the pre- processing increases the N portion of the fuel, pre-processing is an effective way to reduce N_2O. In the area of motor vehicle emissions, N_2O generation trends according to differences in the composition of catalysts and the effect of the deterioration of catalysts on N_2O generation were studied, revealing that it is possible to cut the quantity emitted by selecting catalyst components and by taking steps to prevent deterioration of catalysts. To develop new ways of reducing emissions from domestic wastewater treatment processes, the link between environmental conditions and the quantity of N_2O generated by nitrification and denitrification processes was clarified, clearly demonstrating that it is possible to study optimum operating conditions based on a simulation model. Another study looked at the fixation of CH_4 oxidation bacteria introduced to wetlands and the link between its effectiveness in reducing the generation of CH_4 and environmental conditions. Regarding measures directed at waste material treatment, design conditions that will maximize the CH_4 oxidation by a soil cover were studied by analyzing the transfer and oxidation behavior of CH_4 in final treatment plants with a numerical model using data obtained by both outdoor observations and laboratory experiments. On the subject of wastewater treatment systems, research has demonstrated that increasing the incineration temperature is an effective way to cut emissions of N_2O accompanying the incineration of sludge, and that the increase in construction costs incurred by modifying operating conditions is small and does not effect the service life of the facility. A study to find ways to effectively use digestion gasses from small scale treatment plants has demonstrated the effectiveness of a method of encouraging the pressure absorption of the gas by activated carbon. As a way to process contaminated water and sludge in North East Asia, basic knowledge was obtained concerning the introduction of useful microorganisms, already shown by past research to be effective in reducing the generation of N_2O, to contaminated water and sludge treatment processes. And at the same time as a survey of the state of generation of CH_4 and N_2O from existing eco-engineering type domestic wastewater treatment processes continues, a study of the CH_4 and N_2O generation mechanisms from soil treatment that is particularly widespread in China has revealed a number of operating conditions that reduce the generation of these gasses.