CO_2 Sequestration Research Group

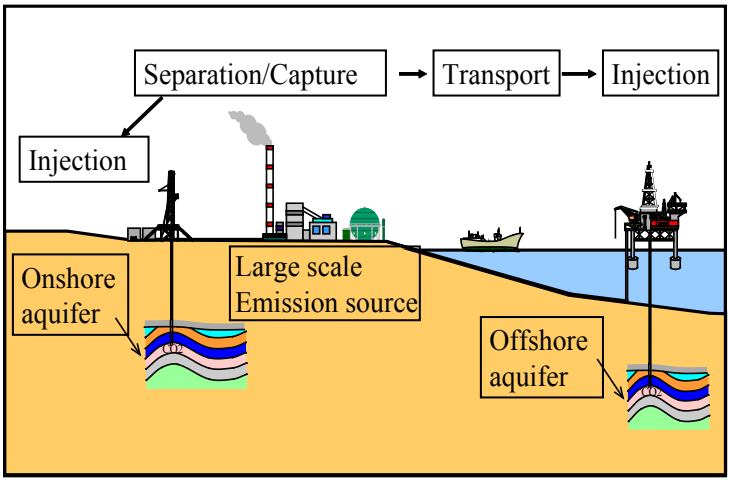
The Outline of CO_2 Geological Storage Project

1. What is the CO_2 Geological Storage Technology?

The CO_2 Geological Storage Technology is to inject CO_2 to the underground safely without releasing CO_2 which is a greenhouse gas to the atmosphere. There are EOR which enhances oil recovery using CO_2 and sequestration to running out gas field, enhancing CO_2 to coal seams for recovering methane and also injection t aquifer which is porous sand stone layer containing ground water as methodologies.

In them, RITE has been developing the geological storage technology which is possible for long term stable reserving by sealed layer.

Also CO_2 geological storage is thought to be one of the most effective and practical technology because knowledge and experience of underground natural gas storage and these of enhanced oil recovery are applicable.



CO_2 Geological Sequestration Aquifer

2. Approach to the project.

"CO_2 Geological Storage technology R&D" launched in October 2000 far-sightedness in recognizing the importance of GHG mitigation efficiency. During 2000 to 2004, verification of geological storage to existing aquifer in Japan was done. Especially the injection testing in Nagaoka city of Niigata prefecture had been operated 10,400 t-CO_2 injection since July '04 until January '05. The measurements consisting of crosswell seismic tomography, well logging, the reservoir formation pressure and temperature measurements, and micro-seismicity monitoring developed CO_2 action simulator. There is no any CO_2 leakage from the reservoir, even a huge earthquake (M6.8) hit the Mid-Niigata area on October 23, 2004. Distance between the earthquake epicenter and the CO_2 injection site is about 20 kms. It has been monitoring underground injected CO_2 for improving forecasting performance.

Nagaoka site

3. R&D subjects of project.

It clears scientific possibility of geological storage in Japan by current approach. On the contrary, in the world, the geological storage technology R&D has been progressed with recognition as mitigation technology. So the step to technology verification should be needed. Then, to clarify the efficiency and to supply the road map towards application and to establish safety analysis methodology using CO_2 activity model, the following approaches has been practicing.

a. Total analysis

(a) Research on validity

Storage system will be classified in terms of source types, capture methods, transporting methods, reservoir types and injection methods. Storage potentials, costs, consumed energy and mitigating effects will be analyzed for each type. A basic scenario plan which will quantitatively explain the validity of geological storage in Japan will be made.

(b) Presentation of a technology and application road map

Technological issues of actual application will be summarized, and a first draft of research and development road map which clears milestones of solutions of subjects will be made.

(c) Investigation on assumed model areas

Assumed model areas will be chosen and issues of actual applications will be extracted by conducting engineering study including safety and environmental assessment on emission sources, transportation methods, reservoir conditions and storage potentials. Solutions for the issues will be proposed.

(d) Storage potential survey in Japan

The aquifer storage potential in Japan will be re-estimated based on the existing data. Locations and types of emission sources will be considered. Issues of the estimation method will be summarized and a new storage model will be proposed.

(e) Investigation of world trend and other relating matters

Overseas investigations on political and technical trends will be carried out and a function of public outreach will be prepared. Investigation and analyses of actual application will be carried out in terms of operating regimes, law and regulations, overseas business potentials and public outreach.

(f) Investigation about safety

Safety studies and assessment trials will be performed and a first draft guideline will be presented. A consistency will be being kept with overseas standards.

b. Establishment of safety analysis methodology

(a) Monitoring at Iwanohara

CO_2 injected at Nagaoka site has been monitoring for confirming the safety storage.The behavior of injected CO_2 in the aquifer will be monitored at the Iwanohara site and a reservoir simulation study will be conducted in order to contribute to the prediction model improvements.

(b) Fundamental researches

In order to contribute to the prediction model improvements the following in-house experiments will be carried out: influence of CO_2 dissolution water on mechanical stability of caprock, quantification of mineral dissolution rates under CO_2 presence, mechanisms of super critical CO_2 substitution for formation water in porous media, etc.

(c) Improvement of a prediction model for underground CO_2 behavior

Based on data and knowledge from the Iwanohara monitoring and the fundamental researches, behavior and fate of CO_2 in and above aquifer for a short and long period will be scientifically summarized and improved prediction methods will be presented for safety confirmation.

4. R&D project issues

It is scheduled that cost and potential, mitigation affects makes CO_2 geological storage effectiveness clear with safety analysis methodology establishment and CO_2 separation technology development towards practical application.

R&D of CO_2 Ocean sequestration project

1. Overview of CO_2 Ocean sequestration technology

Increasing of atmospheric CO_2 is one of the factors of global warming. This is the result of imbalance between the dissolution of atmospheric CO_2 in the ocean and the emission of anthropogenic CO_2, mainly due to the combustion of a fossil fuel. This Imbalance is also due to the long time scale requires for the absorption of atmospheric CO_2 in the ocean in contrast with the rapid increase of emissions. However, there is a sufficient potentiality to dissolve anthropogenic CO_2 in the middle and deep layers of the ocean. Therefore, a bypass technology of direct injection of atmospheric CO_2, captured from high emissions, into the deep ocean was proposed. The main objection for the utilization of this technology is the resulting biological impacts when the initial concentration of injected CO_2 is high. From the viewpoint of suppressing environmental impact to the minimum extent, RITE is developing a dilution & injection technology to the middle and deep ocean layer using “Moving Ship” approach, as shown in Fig. 1.

2. Purpose of R&D

In order to implement the anthropogenic CO_2 sequestration into the ocean as a practical used technology, it is important a prior understanding of the environmental impacts, especially onto the biosphere, to prevent possible damages caused by the application of this new technology. Therefore CO_2 sequestration technology can be clearly understand with a wide social receptiveness among the international frameworks, such as Framework Convention on Climate Change (FCCC) and Convention on the Prevention and of Marine Pollution by Dumping of Wastes and other Matter (London Convention, LDC). This project is being carried out with the purpose of clarifying these subjects towards the utilization of CO_2 ocean sequestration. In addition, during the phase 1, carried out from FY1997 to FY2001, macroscopic CO_2 action grasp in the adjacent seas of Japan, including predictions and investigations of environmental effects, mainly on the biota, produced by the nozzle back discharge of CO_2, were conducted. Following the development of technologies, the aims of the present phase 2 in FY2002 - the FY2006.

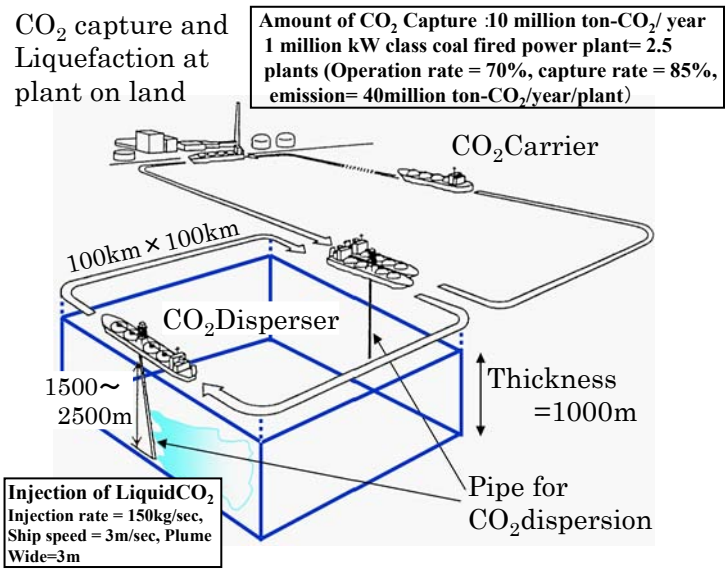


Fig.1 Image of enterprise for ocean sequestration by Moving ship

a. Technical evaluation of CO_2 ocean sequestration capacity
(a)Technical evaluation of CO_2 sequestration capacity
(b) Economical evaluation of the CO_2 sequestration effect
(c)Investigation of positioning on International Law
b. Development of Environmental-impact-assessment technology
(a) Investigation of marine environment
(b) Understanding of deep-sea ecosystem
(c) Investigation of Biological impact
(d) Development of Biological impact model
c. Development of CO_2 dilution technology
(a) Development of CO_2 injection equipments
(b) Improvement of calculation model of CO_2 distribution

3. Present of a project

The phase 2 of this project started from the FY2002, and now it is the 4th year. A middle evaluation of this project by the evaluation subcommittee of Industrial Structure Council of METI was carried out in the 2004 fiscal year. From the middle evaluation, comments and indications are as follows. "Ocean sequestration technology represents a relevant method applicable on global warming. However, there is still a topic, which is to complete the evaluation of the environmental (ecosystem) impacts. Positive deployment of publicity work, international education activities, international joint research, etc. is need." By these indications, RITE has enhanced actions as investigations and PO (public outreach) activities for future cooperation with overseas. Within this context, it is necessary to conclude the so-called "Collaboration of carbon dioxide impact on marine ecosystem" program, being carried out together with NIVA (The Norwegian Institute for Water Research). For this, an experiment will be carried out in a fjord of Norway during the period from August - October of this year. In addition, it is planed a possible international joint research project together with U.S.A, Brazil, and a South Korean. Moreover, in order to promote PO actions, investigations of the PO working group were started from FY2005. The working group has started a working plan on publicity, education and production of PO materials among other actions.

4. Future of the Project

Development of a CO_2 dilution technology and environmental-impact-assessment technology is progressing using laboratory experiments, field observations and numerical simulations. For an effective utilization of the ocean sequestration technology, it is necessary to prove the developed technology using field experiments in the ocean. Finally, it is necessary to trace the CO_2 behavior in several 100 km scale, and to investigate the biological impact. Therefore, field experiments covering a wide range of scale from small-scale to a real scale is desired. Since the ocean is a human common property, the implementation of an ocean sequestration technology needs to build up an international consensus. Therefore, it is necessary to obtain the agreement to ocean sequestration implementation at the “London convention”.